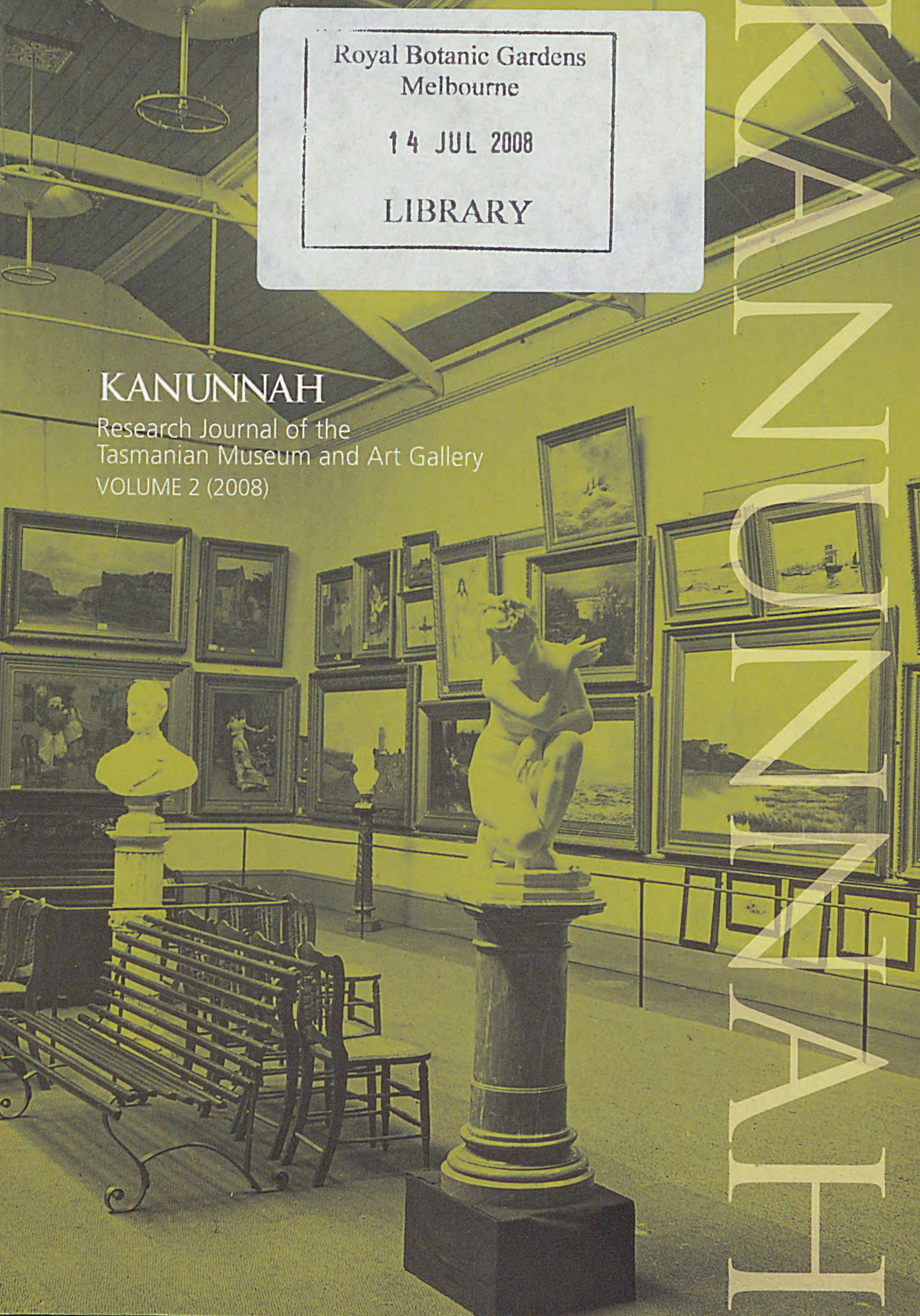

KANUNNAH

Research Journal of the
Tasmanian Museum and Art Gallery

VOLUME 2 (2008)

KANUNNAH

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The Research Journal of the
Tasmanian Museum and Art Gallery

VOLUME 2

Ka-nunnah – 'Thylacine'

The oldest fossils of thylacines are Late Oligocene to Middle Miocene in age (20–25 My B.P.) and are from the Riversleigh deposits in northwestern Queensland (Vickers-Rich *et al.* 1991). It is speculated that competition with introduced dingoes in mainland Australia may have caused their extinction in mainland Australia during the last 5000 years. The most recent remains of thylacines in mainland Australia were dated at just over 3000 years old (Archer 1974).

The thylacine *(Thylacinus cynocephalus)* in Tasmania coexisted with Aboriginal people for millennia. The arrival of Europeans in Tasmania resulted, in just over a hundred years, in the extinction of thylacines from their last refuge. The demise of the thylacine resulted in the extinction of an entire lineage of marsupials from the planet.

To the Aboriginal people of Tasmania the thylacine was called many things due to its wide spread distribution in the State. Tribes from the areas of Mount Royal, Bruny Island, Recherche Bay, and the south of Tasmania referred to the Tiger as 'Ka-nunnah' or 'Laoonana', while tribes from Oyster Bay to Pittwater called it 'Langunta' and the North-west and Western Tribes called it 'Loarinnah' (Milligan 1859). Famous Tasmanian Aboriginal chief Mannalargenna from the East Coast of Tasmania called the thylacine 'Cab-berr-one-nen-er', while Truganinni and Worrady, (Bruny Island) called it 'Can-nen-ner'.

The thylacine is the state logo for Tasmania. The title of the journal 'Kanunnah' commemorates the Tasmanian Aboriginal word used by tribes from southern Tasmania for the thylacine.

Archer M (1974) New information about the Quaternary distribution of the thylacine (Marsupialia: Thylacinidae) in Australia. *Journal and Proceedings of the Royal Society of Western Australia* **57**: 43–50.

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Vickers-Rich P, Monaghan JM, Baird RF, Rich TM (1991) *Vertebrate Palaeontology of Australasia* (Monash University Publications Committee: Melbourne).

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The Research Journal of the Tasmanian Museum and Art Gallery

The Tasmanian Museum and Art Gallery is a combined museum, art gallery and state herbarium. It has the broadest collection range of any single institution in Australia and these collections span the arts, sciences, history and technology. The Tasmanian Museum and Art Gallery's role is to collect, conserve and interpret material evidence on the State's natural history and cultural heritage.

Kanunnah is a peer-reviewed journal published by the Tasmanian Museum and Art Gallery in Hobart, Tasmania. Its aim is to disseminate research in all areas of study undertaken by the Tasmanian Museum and Art Gallery. These areas include the life sciences, culture, history and the arts. Papers on any of these research areas will be considered, but papers dealing with Tasmanian, southern Australian and sub-Antarctic issues will be particularly welcome.

Short communications and reviews are also welcome. Researchers based outside the institution are encouraged to submit manuscripts for publication to the journal, although they must be relevant to the Museum's primary areas of study.

Kanunnah will be published once a year, depending upon budgetary considerations and available manuscripts.

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Cover illustration. The first TMAG Art Gallery, 1895 (detail).
J.W. Beattie, photographer. TMAG: Q2001.15.2.24

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CONTENTS

COURTIER TO THE POWERFUL AND ZEALOUS CURATOR FOR THE PEOPLE: THE CONTRIBUTION OF ALEXANDER MORTON TO THE TASMANIAN MUSEUM AND ART GALLERY, 1884–1907

Joanne K. Huxley

Huxley, J. K. 2008. Courtier to the powerful and zealous curator for the people: The contribution of Alexander Morton to the Tasmanian Museum and Art Gallery, 1884–1907. *Kanunnah* 2: 1–34. ISSN 1832-536X. Alexander Morton was curator and later director of the Tasmanian Museum and Art Gallery for twenty-three years from 1884 to 1907. He presided over the most significant period of change and expansion in the museum's history until the end of the twentieth century. The expansion occurred both in terms of additions to the museum building, which trebled in size in thirteen years, and in terms of the substantial development of the collections and displays. The first public art gallery in Tasmania opened in the extension to the building in 1889. It was also a period in which the administration of the museum was transferred from the Royal Society of Tasmania to the colonial government via a board of trustees. This paper examines Morton's contribution, with a particular focus on his public role as administrator and curator.

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In her survey of the development of colonial natural history museums during the later nineteenth century, Susan Sheets-Pyenson noted the special economic, political and academic challenges faced by colonial curators and the 'paramount importance' of a 'dedicated director' to the success of a museum. The personality of the director was particularly important: 'Only those directors who possessed considerable energy and charisma could mobilise the power and financial support necessary for the survival of their museums'.[1] Although the history of an organisation is never the story of one person, and the support and commitment of the Royal Society of Tasmania must be acknowledged, the special combination of skills offered by Alexander Morton is the best explanation for the significant development of the Tasmanian Museum and Art Gallery (TMAG) between 1884 and 1907. These achievements occurred in spite of considerable financial limitations, with successive governments prepared to fund building extensions but not prepared to increase the maintenance vote. There was also no public funding to assist with acquisitions, a benefit available to some mainland Australian galleries in the later nineteenth century.[2]

Following Morton's death from heart disease at the age of 52, the Chairman of Trustees A.G. Webster, recorded the following tribute to him in the minute book:

> The Trustees desire to place on record their deep sense of the services rendered by the late Director Mr Morton, and of the loss sustained by his death. It is recognised that to Mr Morton's efforts is largely due the two enlargements of the building and to the same cause the valuable contents of the Art Gallery and the large additions to the Museum. To him alone is due the admirable order and arrangement of the specimens. On every side in the Museum and also in the Gardens he has left a lasting monument to services which can hardly be over-estimated.[3]

Morton's value to the museum was widely acknowledged and respected by contemporaries, though not all were impressed by his management style. Honorary government botanist, Leonard Rodway, believed Morton's achievements at the museum came at the expense of the Botanical Gardens and was critical of his dual role as curator and trustee secretary, at one stage describing him as a 'crawler' to the establishment. The radical journal the *Clipper* confirmed this aspect of Morton's style, noting his appearance as a 'courtier' and his 'apparent sycophantic veneer'.[4] For the *Clipper*, however, such characteristics were 'deliberately assumed for his purpose' and that purpose was for the benefit of the museum and community. Likewise, historians have honoured Morton's contribution. J. Somerville noted 'his wide interests and faithful devotion to the Society and to the Museum' and how he 'greatly enriched the Society by means of collections, which were obtained through his zeal'.[5] Gillian Winter and Peter Mercer identified the significance of Morton's appointment; Winter noted particularly his enthusiasm and energy,[6] while Mercer recognised Morton as the most influential and farsighted of the early TMAG curators, and emphasised his important role in organising the Tasmanian International Exhibition in Hobart, 1894–1895.[7] Stefan Petrow acknowledged Morton's valuable contribution to the establishment of the Queen Victoria Museum and Art Gallery in Launceston.[8]

The Royal Society of Tasmania employed Morton in 1884 as curator and librarian; he also became secretary of the society. He was the third curator of Australia's second-oldest museum, which was established in 1848 by Australia's oldest scientific society.[9] Morton had previously been employed as curator's assistant at the Australian Museum in Sydney. He was elected a fellow of the Royal Society in 1884[10] and Linnean Society, London, in 1889.[11] He was a generalist, producing papers on a diverse range of subjects, with a particular interest in ichthyology and ornithology.[12] Morton was a curator and naturalist with a national profile, particularly in terms of the exchanges he developed with mainland museums, and his reputation as a talented field collector. His repute was enhanced by his involvement in the Australasian Association for the Advancement of Science, as secretary for Tasmania from 1890.[13] Morton also developed a sound relationship with overseas museums, corresponding and sharing ideas with such luminaries as Sir William Flower, director of the British Museum (Natural History), 1884–1898. He was active in a number of organisations outside the TMAG and was the first (part-time and honorary) curator of the Queen Victoria Museum and Art Gallery in Launceston from 1891 to 1897.[14]

This study does not attempt to examine all aspects of Morton's contribution to the TMAG, instead it concentrates on his public role as an administrator and curator, exploring how he used a range of political, curatorial and marketing skills to engage with the Tasmanian community to develop the museum.[15] The second half of the nineteenth century saw a rapid increase in the development and expansion of public museums throughout the world, with an increasing emphasis on museums as instruments of popular education. Morton developed a much broader definition of the museum than his predecessors, creating thematic displays of natural history, ethnology, industry, some history and art, all of which he linked together with a special focus on Tasmania. He demonstrated a particular commitment to popular education, and a desire to present not only Tasmania, but also Australia, to tourists at a time when a sense of nation was uncommon in Australian museums (Fig. 1).[16] These elements and the significant public response to the TMAG during the period will be examined.

Fig. 1. Alexander Morton, c. 1904.
J.W. Beattie photographer. TMAG: Q12056

Morton's background and appointment

Morton was born on 11 September 1854 at Hardtimes Landing, Louisiana, and moved with his family to England after his father, Thomas William Morton, a southern planter, lost his property in the American Civil War. Some years later, the family migrated to Queensland where T.W. Morton became general manager of the Manchester Queensland Cotton Company, but died before the company established itself. Alexander Morton worked for approximately two years as a seaman which included some time transporting Melanesian labour to Queensland cotton and sugar plantations. He visited England and Europe briefly before returning to Australia to study the natural sciences.[17] While it is unclear what form his education took, Morton's background proved valuable training for his future career as a curator and natural history collector.

Morton commenced work at the Australian Museum in Sydney in 1877. He was initially employed as a collector to accompany explorer Andrew Goldie to New Guinea, and subsequently as assistant taxidermist and curator's assistant.[18] Morton made a substantial contribution to the museum as a natural history collector. European explorers were only beginning to venture into the interior of New Guinea at this time and Morton succeeded in gathering together a significant collection, mainly comprising birds from forests near Port Moresby and from Yule Island.[19] From 1878 he participated in a number of collecting trips in New South Wales (including Lord Howe Island), Queensland, the Northern Territory, Torres Straits and the Solomon Islands. When he left the Australian Museum he was retained as a field collector and joined expeditions up until the 1890s.[20] During his years at the Australian Museum, Morton became close to Edward Pierson Ramsay, curator from 1874 to 1894.[21] This relationship continued when Morton moved to Hobart and benefited the TMAG, particularly in terms of collection exchanges.

The Royal Society appointed Morton on 25 January 1884 from a field of 51 candidates.[22] The *Mercury* reported that Morton's application 'was supported by very high testimony to his merits'. One of the 'leading scientific men of Sydney' advised the society that Morton 'is so well qualified for such a position that you will make a great mistake if you do not at once secure his services'. Morton is 'a steady, intelligent, hard-working man, whose whole soul is wrapped up in natural history, and he is of such a persevering character that nothing is too hard for him to master ... in fact I consider him the best man on [the Australian Museum] staff'.[23] The society was clearly impressed with his credentials and offered him a salary of £200 for the first year, to be continued if the government grant to the museum was increased.[24] Morton's salary fell far short of that of most of his mainland counterparts,[25] but was £25 more than he had been paid in Sydney,[26] and significantly more than former curator Thomas Roblin's salary of £125.[27] Morton was to take instructions from the honorary secretary of the society,[28] a position continued by James Agnew following his return to the colony from England late in 1883. This was to become a key relationship. Agnew was a medical practitioner, patron of the arts, member of the Legislative Council from 1877, and premier from March 1886 until March 1887.[29] He was an original member of John Franklin's Tasmanian Society, and had a long and significant involvement with the Royal Society and museum.[30]

The creation of a 'national' museum

The 1880s was a period of economic prosperity in Tasmania, creating a climate of optimism and energy among legislators. Reform and progressive legislation characterised the period, and the 'civilising' effect of educational institutions such as museums was emphasised by reformers.[31] In the early 1870s the Tasmanian Public Library had been created,[32] Agnew becoming an early chairman of trustees.[33] There was a growing belief that institutions like the Royal Society's museum and gardens should be transferred to the government to ensure their development, and that they should be 'national' institutions for the benefit of the whole colony. By 1885, apart from Western Australia, Tasmania was the only Australian colony without a museum established on such a basis.[34]

By the time of Morton's appointment, the Royal Society realised that an adequate grant was crucial for the future development of the museum and gardens and intensified its lobbying of government for additional funding.[35] This emphasis is particularly noticeable after Agnew's return to Hobart at the end of 1883.[36] The desire to develop the museum was given greater impetus with Morton's arrival.[37] While his contribution towards developing legislation to form a public museum is not recorded in official documents, it is likely to have been considerable, given the Tasmanian legislation was closely modelled on the Australian Museum Act of 1853. The *Tasmanian Mail* reported that in 1885 Morton had 'recommended to the Council of the Royal Society the desirability of making the Museum a national institution'.[38]

Morton solicited an 'unusually large number of donations'[39] during 1884, and by the following year, the need to expand the existing museum building to deal with overcrowding was pressing, while Agnew was keen to see the development of a public art gallery.[40] Council had discovered that the land on which the museum and gardens stood had never been vested in the Royal Society.[41] Agnew corresponded with Premier Adye Douglas, who advised the society that it would be more likely to obtain approval for an extension if the museum was transferred to the government.[42] In July 1885, Royal Society council members and solicitors James Backhouse Walker and Russell Young presented a draft bill based on the Australian Museum Act. The bill would make the museum and gardens public institutions and ensure that each was provided with a fixed annual grant. Young commented that 'the Government being in their favour, the Society was in a good position in regard to legislation'.[43] Agnew was in a significant position as a member of the Legislative Council when the bill was introduced to parliament. His friends were in government and he had secured the support of Douglas.[44]

Fig. 2. Caroline Morton, c. 1904.
J.W. Beattie, photographer. TMAG: Q1986.27

Morton's wife and journalist, Caroline Morton, who was to make a substantial contribution to the relationship Morton developed with the press, promoted the virtues of the proposed legislation in an article published in the *Mercury* (Fig. 2).

Writing as 'Dio', she claimed the proposed endowments were 'modest sums in comparison with the endowments of similar institutions in other colonies'. The promotion of popular education was seen as a major benefit. With incorporation 'there should come an increased national interest in the varied forms of animal and plant life, so that not only the collections may become larger, but the intelligent interest taken by the mass of the people in what is their own' may lead to the establishment of regional branches 'until the study of natural history, mineralogy, and botany, shall be the recreation of the toilers both in town and country'.[45]

Management and funding

The Tasmanian Museum and Botanical Gardens Act was assented to on 5 December 1885 and came into effect from January 1886.[46] The new board of trustees was potentially powerful, with half the trustees being official appointments.[47] Official trustees attended irregularly though, the main exception being Douglas who became chairman when Agnew died in November 1901.[48] He continued as chairman until June 1904, when A.G. Webster filled the position. The legislation also provided for six trustees to be chosen from the Royal Society council and in practice the society continued to dominate the board through these elected members, who were also part of the colonial establishment.[49]

Clearly, trustees valued Morton (Fig. 3). Commenting on Morton's contribution in his first year as curator, Agnew enthused that his 'zeal, energy, and ability demand special recognition'.[50] In January 1885, Trustee C.H. Grant claimed that 'such an able Curator as Mr Morton ... had metamorphosed the Society altogether by the energy of his exertions'.[51] Morton developed a very successful relationship with the influential council, particularly with Agnew. The combination of Morton's ability and energy, and the power and influence of Agnew were key factors in the development of the museum, particularly in the early years. Morton was also well regarded by Governor Sir Robert Hamilton, who was an active president of the Royal Society and expressed his 'high appreciation' of Morton's services as curator and secretary before he left Tasmania in 1892.[52]

Morton's relationship with the colonial elite owed as much to his political acumen as to curatorial talent and energy, skills no doubt cultivated during his time at the Australian Museum. Ronald Strahan has observed that the Curator E.P. Ramsay owed his position to patronage, and being a protégé of Trustee Sir William Macleay, was on the fringes, at least, of the colonial establishment in Sydney. Morton worked closely with Ramsay and was able to observe at first hand the interplay of characters within the colonial elite in Sydney. Both men understood the fate of Ramsay's predecessor, Gerard Krefft, who was a talented zoologist with progressive ideas, but lacked the political skills to get on with his trustees, which ultimately destroyed his career.[53]

Morton occupied an influential position as both curator and secretary in terms of his access to trustees and government officials, and his control of the paperwork. While a committee of trustees was formed to audit the accounts, Morton appears to have been largely responsible for the administrative work. This became apparent when Caroline Morton had

Fig. 3. The Council of the Royal Society of Tasmania and the Trustees of the Tasmanian Museum and Botanical Gardens, 1899.

BACK ROW LEFT TO RIGHT: Bernard Shaw, W.V. Legge, R.M. Johnston, H.H. Montgomery (Bishop of Tasmania), Russell Young, James Backhouse Walker, Richard Bright, Alexander Morton (curator and secretary).

FRONT ROW LEFT TO RIGHT: C.H. Grant, Thomas Stephens, James Agnew, J.S. Dodds, A.G. Webster, Adye Douglas, Nicholas Brown.

R. McGuffie and Co., photographer. Royal Society Collection: Q16941

difficulty reconciling the accounts for the 1905–1906 financial year following Morton's death, as some of the receipts had been misplaced.[54] Trustees, who had many commitments other than their role on the board, appear to have left most of the work to Morton. The museum trebled in size over the period. With only one attendant, John Arnold, and a messenger boy and being also the secretary and librarian, Morton's workload was substantial. Despite his heavy workload, Morton enjoyed considerably more autonomy than Ramsay, and his successor, Robert Etheridge, who were continually vying with the secretary, Sutherland Sinclair, for administrative control of the Australian Museum.[55] Morton's dual role as curator and secretary, however, led to criticism of a conflict of interest in his dealings with the gardens.

Morton was appointed director of both the museum and gardens in January 1904,[56] following the death of superintendent Francis Abbott.[57] Some individuals were not happy with Morton's dual role, and the resulting conflict contributed to a degree of disillusionment in the final period of his office. John Wardman, who had worked at the gardens for fifteen years and hoped to secure Abbott's position, was appointed as acting foreman only, and required to work under Morton's direction.[58] In November, Wardman accused Morton of attempting to 'supersede' him,[59] later admitting that the government botanist, Leonard Rodway, was the author of his letter.[60] Subsequent meetings reveal that Rodway had written a number of letters to trustees criticising Morton's character.[61] He had written 'knowing what a rich schemer our friend Morton is and how he was slowly crawling himself into the unfortunate Wardman's shoes ... I had written you drawing your attention to the Trustees' moral obligation towards Wardman'.[62] Rodway later apologised and withdrew his complaint.[63]

Following Morton's death in 1907, far stronger criticism was made of him. Rodway, who presumably had become aware of the problem with the accounts, and was furious that the trustees would not release Wardman to assist in establishing a state nursery, wrote to Premier J.W. Evans, questioning the suitability of the trustees and accusing Morton of having been 'an incompetent amateur Director of the Botanic Gardens'. He continued 'we now find that during that period ... a sum aggregating probably more than £600 of money voted specifically for the upkeep of the Gardens has been misappropriated'.[64] Rodway implied that the funds had been redirected to assist the museum, claiming that Abbott 'eight years ago told me he could not bring his gardens up to date because part of his vote was being used to liquidate an overdraft incurred at the Museum.'[65] Trustees strongly refuted the claims, sending the government a statement of expenditure on the gardens from 1886 to 1906.[66] The statement suggests the government vote for the gardens was correctly expended.[67] In November, Rodway withdrew his complaint; he offered no apology, however, and clearly believed that Morton's period of office had been detrimental to the gardens.[68]

Although there is no evidence that government funds for the gardens were misappropriated, profits from the sale of plants were used to reduce the overdraft with trustee approval in 1903 and 1904, amounting to £126.[69] The overdraft stood at £348 in 1903 and was mainly caused by construction of the third stage of the museum.[70] Morton made a significant personal sacrifice to reduce the debt in 1904, asking that his pay increase be deferred for at least a year.[71] It would be unfair to claim that trustees did not act responsibly towards the gardens. From 1886 they made numerous appeals to government to provide funding for improved infrastructure. These had little success,[72] however, and there can be no doubt that the museum had priority over the gardens.

The conflict between Morton and Rodway reveals a clash of ambitious interests and an important difference in emphasis. Both men were of a similar age and keen to make their mark in the scientific community, yet neither was a university-trained scientist, Rodway having originally qualified as a dentist. Rodway, who was to serve as a Trustee of the Tasmanian Museum and Botanical Gardens between 1911 and 1928 and then as director of the latter, stressed the scientific and economic role of the gardens as a nursery for acclimatisation and experimentation.[73] Morton as with the museum, emphasised the public and popular educational role.

The TMAG was comparatively worse off than most mainland museums and galleries in terms of funding during the period, even allowing for the general hardship caused by the economic depression of the 1890s. In 1897 Agnew compared the respective amounts granted to the museums of Western Australia and Tasmania: 'The former, which is not one-half as large as the latter, receives four thousand pounds annually; we receive five hundred'.[74] The government vote of £500 guaranteed by legislation in 1885 did not increase between 1886 and 1907. In fact, the Braddon government, in response to the depression, attempted unsuccessfully to reduce the vote for the museum and gardens by £200 for 1896.[75] Successive governments, although prepared to fund building extensions, would not agree to an increase in the maintenance vote. Carolyn Rasmussen noted a similar difficulty at the National Museum of Victoria, observing that new buildings 'are especially attractive to politicians since they stand as clear, unambiguous monuments to their largesse'.[76] Less political advantage was gained by funding ongoing maintenance. From 1891 trustees also repeatedly asked the government to provide a special annual fund for the purchase of art works for the TMAG, without success.[77] By the later nineteenth century, some mainland Australian galleries benefited from the provision of a special acquisition fund, most notably the Art Gallery of New South Wales.[78]

In 1904 the TMAG received, from the estate of Lady Dry in London, a valuable collection that included art works, books and coins.[79] When the government asked trustees to contribute to the cost of bringing the collection to Hobart, Morton wrote a strong letter to Premier Evans, highlighting his growing resentment at the lack of government funding.[80] Morton's strength of feeling about the funding situation and his conflict with Rodway may have been among the reasons why, by 1905, he had begun applying for other positions. In June, 1905 he sought the vacant position of director at the Queensland Museum, following the retirement of Charles de Vis. In a letter to Mr Bailey in Queensland (likely to be Frederick Manson Bailey, colonial botanist), Morton advised 'My position in Hobart brings me in £350 per the annum – house and rates. I am rather inclined to say with the same offer I would be prepared to accept a position at the Brisbane Museum' and 'I have had for many years a longing to try Queensland'.[81] Morton's willingness to move to a new position in Queensland for the same salary, following twenty-one years of considerable achievement at the TMAG, is a good indication of disillusion. Morton's application to the Queensland Museum was probably later withdrawn. The annual salary of de Vis had been reduced from £400 to £300 during the depression of the 1890s. Economic recovery was slow, and by the time of de Vis's retirement, the government was seeking to further reduce the salary of the director.[82]

Following Morton's death in 1907, Caroline Morton was requested to act as secretary to the trustees and the Royal Society.[83] She occupied this position until January 1908 when Robert Hall commenced as the new curator. While it is unlikely she undertook the full duties of curator, Caroline Morton's appointment

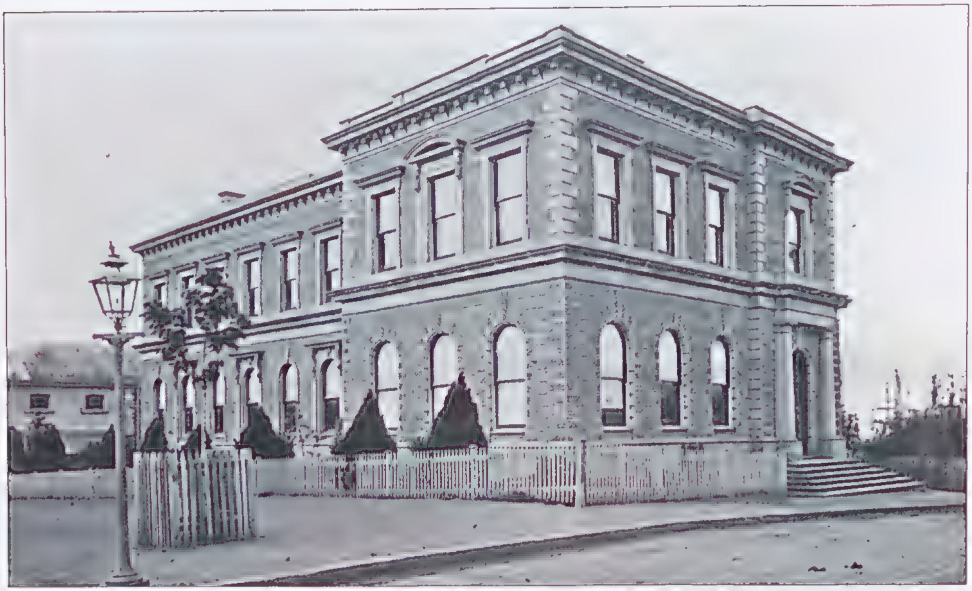

Fig. 4. The Royal Society Museum on the corner of Argyle and Macquarie streets, Hobart, early to mid 1880s. The Commissariat Store can be seen in the background.
ANSON BROTHERS, PHOTOGRAPHERS. TMAG: Q10557

must have been unusual for the period, suggesting not only that she was very capable, but also that she had assisted Morton in the past. For a period of three months she was paid Morton's full salary.[84] In July, her offer to continue acting as secretary from 1 September until 30 November at half salary was accepted.[85] Her employment on these terms was later extended until the end of the year, enabling trustees significantly to reduce the overdraft.[86]

Building expansion

By early 1863 the Royal Society Museum had moved from overcrowded premises in Harrington Street to a new purpose-built museum on the corner of Argyle and Macquarie streets, the site being provided by the government. In 1861 Hobart architect Henry Hunter won a competition for his design for a substantial stone building in the Renaissance Revival style.[87] The plan was for a building symmetrical to Macquarie Street, with the potential for a further wing at each end, running parallel to Argyle Street. For financial reasons, only the central portion was built, providing the society with three exhibition galleries and a combined library and meeting room.[88] The contractor was Seabrook and Son. The total cost of the building was £3772, plus fittings. This was partially funded by a government grant, with over £1800 being raised by public subscription, largely through the efforts of society secretary, Dr Joseph Milligan (Fig. 4).[89]

Following the successful passage of the incorporation bill, parliament voted a sum of £3000 for the erection of the new Argyle

Street wing during the session of 1885.[90] Agnew, who became premier in March 1886, presided at the ceremony to lay the foundation stone, held on 23 December.[91] Hunter designed the wing in conformity with the original building, and the tender was won by contractors Duncan and Crow with a bid of £2550.[92] The Tasmanian Art Association used the upper room for an art exhibition from January 1889, and the exhibition was opened to the public for two weeks in March.[93] Morton's intention to fit out the lower room for Australian collections of natural history was delayed until May, due to a decision to replace the pillar supports in the room with iron flitches, to create more display space.[94] Governor Hamilton officially opened the new wing on 21 May 1889, and the museum became the Tasmanian Museum and Art Gallery.[95]

Although Morton is likely to have been involved in the negotiations for the second stage of the museum, the records indicate that Agnew was the principal canvasser, a likely role given his position in parliament. Morton's role in attaining the third stage of the museum is more clearly reflected in the records and demonstrates his growing dominance in a management sense. In July 1891 Morton advised trustees that he had written to Premier and Chief Secretary P.O. Fysh 'urging upon the Government the necessity of completing the Museum building according to the original designs'.[96] He advised that a reply had been received confirming that a vote for the proposed extension would be included in the public works proposals to be submitted to Parliament.[97] The approved funds were later postponed because of the economic downturn of the early 1890s.

Improved economic conditions by the turn of the century and an increased desire for civic progress on the eve of Federation, best explain the renewed push for the third stage of the museum in 1900.[98] The proposal enjoyed bipartisan support when discussed in the House of Assembly and provided evidence of widespread respect for Morton's achievements. Minister of Lands and Works, Edward Mulcahy acknowledged the amount 'was merely a restoration of money that had been voted in 1891' temporarily postponed due to the state of the colony's finances. Leader of the Opposition Sir Edward Braddon 'recognised that the institution was one of a national character, to which all members might reasonably give their support'. Ringarooma member, Carmichael Lyne 'saw merits about the South as well as the North' and 'having such a good museum in the capital … and a curator looking after it as Mr. Morton did, taking the greatest care of everything put into it, he thought all the space required should be supplied'.[99] In the Legislative Council, Chief Secretary and Launceston member (and Douglas's stepson) George Collins, argued that the vote was 'very necessary to extend and improve a very valuable, splendidly-managed and much appreciated institution'.[100] In November trustees were advised that the sum of £4000 for the extension had been passed by parliament.[101] The tender was won by contractors W.H. Cheverton and Son with a bid of £4197. Construction was supervised by the Department of Public Works.[102]

The Administrator and Chief Justice, Sir John Dodds, laid the cornerstone on 20 March 1901,[103] and Governor Sir A.E. Havelock officially opened the third

Fig. 5. The Tasmanian Museum and Art Gallery after completion of the third stage, April 1902. TMAG: Q1961.81.12

stage on 29 April 1902 (Fig. 5).[104] Although the original design prepared by Hunter in 1861, was adhered to externally, the interior was designed by architect Orlando Baker to accommodate more up-to-date structural techniques. The use of iron girders and steel joists obviated the need for pillar supports on the ground floor, creating considerably more display space. The two-storey extension created two large galleries 93 feet [28.3 m] in length and 26 feet [7.9 m] wide. The ground floor gallery was designed with an ornamental embossed metal ceiling and provided a more suitable space for the Tasmanian Room.[105] The art gallery on the first floor had eleven large skylights and the roof was covered in Welsh slate. Three large air pump ventilators were fixed in the roof, connected to 'large galvanised iron shafts, with ornamental zinc ventilating centres fixed in the ceiling'. 'Tasmanian blackwood guard rails upon turned blackwood newels [were] fixed around the gallery to protect the pictures from injury.' An ornamental staircase constructed from blackwood and Huon pine provided access from the ground floor.[106]

The 'open court' between the 1889 and 1902 buildings was enclosed by brick walls, creating a space 64 by 56 feet [19.5 m by 17 m]. The area was covered with an iron roof, with light being provided through a large lantern in the centre and skylights. The court displayed objects and trophies promoting key Tasmanian industries.[107]

Fig. 6. The new Trophy Room, showing the Tasmanian timber trophy and 600 photographs of Tasmanian scenery by J.W. Beattie, 1902.
J.W. Beattie, photographer. TMAG: Q1989.49.4

Morton had written to Tasmanian mining companies, inviting them to erect a trophy for the new exhibition court.[108] The TMAG report for 1902 noted 'A splendid trophy ... showing the commercial timbers of Tasmania' and another 'erected by the Directors of the New Golden Gate Mine, showing the output of that mine in gold during the period of its existence'.[109] Also displayed were some 600 photographs prepared by J.W. Beattie 'representing the beautiful scenery of Tasmania'.[110] The Tasmanian Tourist Association supplied the photographs, the president, Henry Dobson, having established an office of the association at the museum in 1898.[111] Morton and Beattie, who were both members, were keen to encourage the growing interest in tourism, Morton recognising the political and economic benefits to be gained for both the museum and the state by promoting these key industries (Fig. 6).[112]

Museum exhibits

Thomas Roblin was well regarded by the Royal Society, and when he died in 1883, following twenty-one years of service as curator, he was described as a 'most faithful, zealous, and efficient officer'.[113] He did receive criticism for the state of his displays, a correspondent to the *Mercury* in 1877 commenting 'It is a matter for great regret that the Museum ... is so very badly planned and exhibited'.[114] The writer was disappointed with the classification and arrangement of the specimens. Agnew replied that allowing for the limited gallery space and the 'totally inadequate' government grant of £200 per annum, 'seldom has so much efficient work been accomplished under less favourable circumstances'.[115] Other commentary added weight to the correspondent's view. In 1895 Chief Secretary, William Moore, observed that Morton had 'evolved a system of classification and arrangement' from 'a state of comparative chaos'.[116] The *Clipper* agreed, describing the museum prior to Morton's arrival, as being 'in a simply chaotic condition: a mere dusty jumble ...'.[117]

When Morton commenced work as curator in 1884, he first concentrated on improving and developing the exhibits of Tasmanian natural history and geology. At year's end, Agnew noted 'a marked increase of interest in the Museum ... shown by the unusually large number of donations from divers [various] parts of the colony'. The Tasmanian collections 'have been re-arranged according to their natural orders, and many new ones have been prepared and mounted'.[118] In July 1885, the *Mercury* commended Morton's achievements: 'With such an energetic worker' as Morton 'the public will evince no surprise to hear that the progress made by the institution during the past year has been greater than that of any previous year since its initiation'.[119]

Morton's aim was 'to create at a glance, a microcosm of Tasmania'.[120] Carefully compiled labels, descriptive of the various groups and sections were prepared in a clear and concise manner accessible to the general public.[121] In 1887 the trustees reported that the Tasmanian collection 'is highly appreciated by the general public, and particularly by visitors to the Colony' and also that 'different schools in Hobart visit the Museum for educational purposes, proving that the Institution is becoming instructive as well as popular'.[122] The notion that displays should be both instructive and popular was central. Popularity was essential for continued community and political support to develop the museum, and accorded with Morton's belief that the museum should provide instruction to a wider group of people than the educated elite.

Another important purpose of the Tasmanian collection was to promote the colony's wealth of natural resources, particularly to visitors. As Morton noted, 'Many hundreds of passengers on their way to New Zealand in the direct steamers from London call at Hobart, and one of the first places visited is the Tasmanian Museum'.[123] Key industries were well represented, particularly the mining and timber industries.[124] Despite limited space and resources, Morton collected and renewed exhibits for the Tasmanian Room, largely relying on donations from the public, and demonstrating considerable skill in terms of his display technique. In 1885 'a unique group of a female Tasmanian tiger, with four young ones' was presented to the museum and Morton 'arranged the young ones with graphic ingenuity'. Among the reptiles 'there is added a striking group of snakes and lizards, crawling about an imitation rocky bank'.[125] The Tasmanian Room was his first priority and in 1893 Morton exchanged its

Fig. 7. The new Tasmanian Room, 1902.
J.W. Beattie, photographer. TMAG: Q1989.49.3

location with the Australian Room, moving the former from the first floor of the 1863 building to the more prominent ground floor gallery of the 1889 extension.[126] In 1902 the Tasmanian Room was moved to a larger gallery in the new building, underneath the art gallery (Fig. 7).[127]

Although, in general terms, colonial museums followed a similar pattern of development to their counterparts in Europe during the nineteenth century, human history and a sense of nation were generally absent from Australian museums. Their focus was mainly on the natural sciences, technology and art. The small amount of historical material collected by Australian museums was largely paper-based documentary material.[128] Aboriginal material was also increasingly collected from the last quarter of the nineteenth century, though classified as 'ethnology' rather than 'history'.[129] Morton featured Aboriginal material culture and human remains in the Tasmanian Room, and in 1904 placed Truganini's skeleton on display.[130]

In 1889 Morton dedicated the new ground -floor gallery to Australian collections, principally natural history specimens, minerals, fossils and Aboriginal material. Later the room was also used for New Zealand collections.[131] Morton's desire to promote not only Tasmania, but also Australia to tourists suggests he was engaging in nation building. Morton was keenly interested in the federal debates of the period,[132] and given his background, his sense of 'national' is likely to have been all the wider. It is also possible that the concept of the Australian Room was developed as early as 1885 to appeal to Douglas who was an ardent federalist. At the first session of the Federal Council held in Hobart in 1886, Douglas caused considerable controversy in his speech as premier by predicting a 'United States of Australasia … independent of the little island in the Northern Hemisphere'.[133]

Although the Australian Room was mainly devoted to natural science, a few historical items were also included: 'Over the fireplace are suspended photographs of Burke, Wills, and King, and on the mantelshelf is a bust of Leichhardt, names which will be familiar to all acquainted with Australian history'.[134] Earlier, the general room had included a large collection of medals and ancient coins including gold and silver medals awarded to the Tasmanian Commissioners at the London Fisheries Exhibition of 1883. Also on display were 'the silver egg-cup, teaspoon, and sugar-tongs which formerly belonged to an officer of Captain Cook's ship when accompanying that great discoverer on his voyage round the world'.[135] Artefacts commemorating celebrated historical characters or events were collected, and Morton exhibited Sir John Franklin's 'relics' at the Tasmanian International Exhibition in 1894.[136]

In 1898 an old convict wagon, originally used at Macquarie Harbour, was offered to the museum. Morton consulted Agnew who declined the offer. Agnew had worked as a convict surgeon earlier in his career and he may have had negative feelings about his convict experience. A desire to forget the convict past was common at the time.[137] If convict artefacts were unsuitable, Governor Arthur's proclamation to the Aborigines was approved of. In the same year, S. Colvin, keeper of the Department of Prints and Drawings at the British Museum, acknowledged receipt of a copy sent by Morton.[138]

The quality of Morton's exhibits owed much to the sound relationship he established with mainland museums, particularly the Australian Museum. The Royal Society had previously participated in collection exchanges with the Australian Museum, and Morton's friendship with E.P. Ramsay strengthened this relationship, ensuring a regular exchange of collections between the two museums, mainly favouring the TMAG.[139] This arrangement was enhanced by Morton's work for both museums as a field collector and continued into the 1890s.[140] Morton shared Ramsay's particular interest in ornithology and ichthyology, and also his talent for soliciting donations. They differed in their approach to display however. Strahan described Ramsay's attitude as 'extremely conservative' with an approach 'that tended to regard beautiful cabinets as more important than informative labels'.[141]

Despite having limited duplicate specimens, and giving priority to Australian materials, Morton exchanged specimens with overseas institutions when he could. He was committed to developing

Fig. 8. The new Ethnology Room (formerly the Art Gallery), 1902. This room displayed collections from Australia, New Zealand and the various islands of the South Pacific.
J.W. BEATTIE, PHOTOGRAPHER. TMAG: Q1989.49.2

displays of comparative material for the general room, corresponding with numerous museums and individuals.[142] He also secured valuable donations from expeditioner T.W.H. Clark. In 1889, during shooting expeditions in the Rocky Mountains, Clark collected 'some splendid specimens ... including a very fine deer and a grizzly bear, which he had stuffed and forwarded to the Museum free of all charge'. In 1891, he presented 'a magnificent antelope, mounted in London by the well known firm of Rowland Ward'. The beatrix antelope (*Oryx beatrix*), captured in Somaliland, had not previously been exhibited in Australasia.[143] Morton also secured valuable donations from overseas visitors. In 1897 an English visitor agreed to present 'an Egyptian mummy with the original coffin and writings as found when excavated'. From the inscription, it appeared that the mummy was an Egyptian princess. Previously the only museum in Australasia possessing an Egyptian mummy was the Christchurch Museum in New Zealand.[144] In 1899 another English visitor presented a collection of British birds, labelled, and mounted, valued at £270.[145]

In 1889 Morton corresponded with William Henry Flower, who had succeeded Richard Owen as director of the British Museum (Natural History) at South Kensington in 1884. Morton was impressed with Flower's address to the British Association for the Advancement of Science, in which he advocated the arrangement of museum displays to better promote popular education. Flower described a well-arranged educational museum, as 'a collection of instructive labels illustrated by well-selected specimens'. He claimed the curator 'must carefully consider the object of the museum, the class and capacities of the persons for whose instruction it is founded, and the space available to carry out this object'. He also emphasised the importance of thoroughly representing the local fauna and flora of a district.[146] Morton advised this was the approach he was adopting at the TMAG and Flower replied 'You seem ... to be in little need of advice or instruction as to museum matters, being evidently ahead of most others that I know of' and 'the labels that you have sent me are exactly the kind that are wanted to make a Museum useful and instructive, and such as we are largely introducing here'.[147]

By the late nineteenth century, the Natural History Museum had become the world authority for museum practice and the primary model for colonial museums. Flower was the leading advocate of the 'new museum idea', which involved the separation of study and exhibition specimens. In contrast to Owen, who had favoured a comprehensive scheme of display, Flower believed that numerous specimens representing specific and varietal forms had little value for the average visitor and should be placed in special study rooms for the use of students. Selective rather than comprehensive exhibits should be displayed in uncrowded cases with clear and instructive labels.[148] Owen's preference for comprehensive exhibits had been influential, and certainly influenced Professor Frederick McCoy at the National Museum of Victoria. The two ideas co-existed for some time, but by the end of the century, selective exhibits became the favoured approach. This approach was adopted by McCoy's successor, Professor W. Baldwin Spencer, when he became director in 1899.[149]

In 1893 British Museum curator F.A. Bather wrote a paper entitled 'Some Colonial Museums', printed in *The Report of the Museum Association* (London), for 1894.[150] The paper detailed the findings of his pioneering survey of British colonial museums and commended the arrangement of displays at the TMAG. He described the arrangement of the exhibits as 'neat and effective'. In each of the three natural history rooms specimens were classified by the four sciences of zoology, botany, geology and mineralogy; the last 'being largely devoted to the practical illustration of the mining industries of the country'. He particularly noted the completeness of the Tasmanian collection of native fauna, fossils, rocks and minerals; the large number of type specimens of land and freshwater molluscs, and the Tasmanian fossils illustrated by R.M. Johnston and R. Etheridge. Bather was impressed by Morton's labels, claiming that they 'are excellently inspired by what we may call the new museum spirit'. He observed 'It is no easy matter to draw up a label that shall interest and be intelligible to the general public, and at the same time shall not provoke the scoffs of the specialist; yet this difficult task is admirably accomplished at Hobart'.[151]

Bather attributed the popularity and success of the museum to the efforts of Morton, and the continuing connection between the museum and the 'flourishing Royal Society of Tasmania'. He also noted the 'lively interest' taken by Morton in the technical school in Hobart, and the university extension lectures given under the auspices of the University of Tasmania. Bather concluded 'Few of the many museums that I have visited show to so large an extent the results that can be achieved by a curator possessed of enthusiasm and intelligence, and ready to co-operate with, rather than to rival, the other scientific institutions of the neighbourhood.'[152] In 1895 Bather wrote to Morton advising that he would like to publish an account of the museum in *Natural Science*, 'a journal that makes a specialty of giving descriptions of museums illustrated by plates'. He requested 'original blocks' of the interior of the museum, and copies of the labels used for exhibits. Morton was authorised to obtain the necessary images, which were prepared by Beattie and later published in the *Tasmanian Mail*.[153]

Art Gallery

Agnew demonstrated his particular commitment to the establishment of a public art gallery at the foundation stone ceremony for the second stage of the museum in 1886. The gallery 'would be a great object of attraction to the public' and as a national gallery 'would be open to them without money and without price'. 'This was truly promoting the interests of art.' Agnew emphasised the importance of cultivating a taste and love for art in the community, as the emergence of 'art culture' would be one means of 'introducing the element of refinement into the natural character'.[154] Morton, too, recognised the educational value and public attraction of art, and, although not having a professional background in the field, enthusiastically supported the development of the gallery. He added prestige to the occasion by inviting Julian Ashton, president of the Art Society of Sydney, and vice-president of the National Art Gallery of New South Wales, to the opening ceremony. Ashton was also consulted about the arrangement of the new gallery.[155]

On opening day, the art gallery exhibited a number of paintings by the gifted Tasmanian-born artist, William Charles Piguenit. These had been presented by the Tasmanian Government and included 'a splendid view of Port Esperance, with Faith, Hope, and Charity Islands in the distance'.[156] Other Piguenit paintings of Tasmanian scenes were provided to the gallery on loan.[157] Later, the government presented eight black-and-white paintings by Piguenit of the Western Highlands of Tasmania. Morton recognised the considerable artistic merit of Piguenit's paintings and their benefit to tourism: 'Valuable as they are as works of art', they 'have been of great interest in attracting the attention of visitors to the unrivalled scenery of the almost untrodden uplands of Tasmania, and will probably be the means of stimulating tourists to search for beauties of which they had no conception'.[158] The permanent collection also included four portraits of Tasmanian Aboriginals by Benjamin Duterrau, and

Fig. 9. The first Art Gallery, 1895 (detail).
J.W. Beattie, photographer. TMAG: Q2001.15.2.24

fourteen similar paintings by convict artist Thomas Bock.[159] A number of pictures by British and European artists were also exhibited, on loan, at the opening.[160]

Morton was committed to developing a representative collection of international art. He recognised that the educational strength and popularity of a major gallery such as the Art Gallery of New South Wales, was that it possessed 'works by many of the leading men of the world'.[161] At the TMAG a number of celebrated European and British artists was represented.[162] Colonial art was also valued, and artists represented in addition to Duterrau, Piguenit and Bock included John Glover, Benjamin Sheppard and Sydney artists Julian Ashton, A. Henry Fullward and W.L. Hopkins. By 1896, due to the joint efforts of Morton and Agnew, and the generosity of benefactors, the gallery possessed as gifts and loans more than 200 works of art 'of high order of merit' and 'many of the paintings are from the brushes of recognised artists, whose pictures have had the honour of being placed in the line at the Royal Academy' (Fig. 9).[163] Morton also exchanged art works on loan with the Art Gallery of New South Wales.[164] He sought to encourage local artists by inviting

Fig. 10. The new Art Gallery, 1902.
J.W. Beattie, photographer. TMAG: Q15262

the Tasmanian Art Association to make use of the gallery for their annual exhibitions,[165] and the association, on occasions, assisted in the selection of works for the gallery.[166] To encourage the educational value of art, the gallery was closed on Mondays and Thursdays from 1887 to enable students to improve their drawing by copying the paintings.[167]

Before the close of the Tasmanian International Exhibition in 1895, Morton, who was a director of the management committee, successfully negotiated the extended loan of some 96 paintings, mostly by British artists, that had been shown at the exhibition.[168] The paintings were exhibited in the refurbished art gallery, officially opened on 14 June 1895.[169] Several of the artists agreed to lend their paintings for at least one year, and three agreed to present their work to the TMAG.[170] While the paintings were on display, Morton corresponded with a number of commercial organisations in an attempt to persuade them to purchase works for the gallery, including the Australian Mutual Provident Society in Sydney.[171] He also organised a fundraising 'Grand Concert' performed

Fig. 11. The Royal Society of Tasmania Library and Members Room (formerly the Tasmanian Room), 1902. J.W. Beattie, photographer. TMAG: Q1989.49.1

at the Hobart Town Hall.[172] While it is unclear whether these fundraising efforts led to the purchase of paintings, some did remain in TMAG's collection, and the loan provided the Tasmanian community, visitors and particularly students, with free access to an unprecedented number of British Royal Academy oil and watercolour paintings.[173]

Public response

Public support of the TMAG in terms of collection donations during the period was outstanding. Webster commented in 1907 that 'the increased value to the State in the various sections cannot be estimated at a lower value than from £20,000 to £25,000'.[174] Donations to the art gallery formed the greatest part of that value. In 1904 Morton reported that the art collection was valued at over £10,000.[175] The total value of donations is even more impressive when it is realised that the government endowment for the maintenance of the museum between 1886 and 1907 was only £11,000.[176] Conversely, there is little evidence of cash donations. In 1885 the Royal Society received a bequest from Milligan's estate, including a £100 portion for the museum.[177] The only other significant donation mentioned in the minutes was for £20 donated to the art gallery in 1894 by former Premier and Chief Justice Sir Francis Smith.[178]

Anonymous donations were received to assist in the renovation of the art gallery in 1894.[179] There is also evidence of support-in-kind. Annual reports from 1898 thanked the management of the Tasmanian Railways, Union Steamship Company of New Zealand, and Huddart, Parker and Company for agreeing to carry museum goods free of charge.[180]

In 1877 the Royal Society commenced opening the museum on Sunday afternoons and, despite some criticism for opening on the Sabbath, the move proved very popular with the general public. In 1878 almost half of the 33,466 visitors came on Sundays. From 1879, however, visitor numbers began to decline.[181] In 1885 Thomas Reibey commented in parliament on the large number of visitors at the museum during the year. He had visited the museum the previous Sunday 'when there was a very large attendance, consisting chiefly of labouring men and their friends, and they seemed to take a very great interest in the collections'.[182] In 1885, 27,069 people visited the museum.[183] Following the first extension to the museum and the opening of the art gallery in 1889, he calculated that the average attendance on weekdays was 150 with 500 on Sundays.[184] The regular attendance of 500 on Sunday afternoons gave a yearly total of about 26,000 visitors for Sundays alone. These numbers increased substantially during special exhibitions or with a large influx of tourists. On occasions the number of Sunday visitors reached 800, with school visits boosting weekday attendances.[185]

In 1901 Morton again estimated an average attendance on weekdays of 150, and on Sundays 500.[186] This amounted to 65,000 visitors annually, about thirty-eight per cent of Tasmania's total population.[187] Morton estimated an average weekday attendance of 200 in 1904.[188] Attendance figures were not recorded in the six years following Morton's death, and by 1912, presumably for financial reasons, the museum was no longer open on Sundays.[189] In comparison, the estimated daily attendance at the Botanical Gardens between 1886 and 1902 ranged between 150 and 200 visitors daily.[190] The Tasmanian Public Library conducted a census of visitors in 1902 and calculated an average attendance of 326 on weekdays and 158 on Sunday afternoons.[191] The comparatively large attendance at the museum on Sunday afternoons is evidence that Morton was very successful in attracting workers and their families, and tourists to his exhibits.

Public commentary was generally positive and mostly conveyed in letters and articles published in the press. Some criticism of Morton's geology and mineralogy displays is evident in letters to the editor published in the 1892 *Mercury*. One was published under the pseudonym 'A Naturalist and Visitor'. The writer stated 'having heard the Curator boasting of [the museum] at the Association for the Advancement of Science in Melbourne last year as an exemplar for all other kindred institutions in Australasia, I expected to find things very different from what exists'. The critic highlighted 'An entire absence of systematic arrangement and classification' of the geology and mineralogy collections.[192]

Criticism of this kind is difficult to reconcile with other commentaries praising Morton's work. In July 1895, Agnew wrote to the *Mercury* advising readers of Bather's assessment of the TMAG.[193] Agnew had prepared the letter as part of the Royal Society's campaign against the government's attempt to reduce the vote to the museum and gardens in 1895, due to the economic downturn. The debate that followed provided further commentary. In a letter to the *Mercury* entitled 'Science and the Treasures Axe', soldier and scientist Colonel W.V. Legge observed 'No man has worked harder than the present curator ... in remodelling and rearranging the collections, adding to them and rendering them instructive ... to cripple his work by cutting off funds is a somewhat ghastly reward for his labours to the country'.[194] Similarly, W.C. Piguenit, who had been assisted by Agnew earlier in his career,[195] lamented the proposed reduction of the vote to the museum and gardens. Piguenit, now residing in Sydney, compared the funding provided in Tasmania with that available to comparable institutions in New South Wales, concluding 'When it is remembered how small has been the expenditure in Tasmania ... the most carping critic must admit to what admirable purpose those to whom this expenditure has been entrusted have fulfilled their duty'.[196]

For 'Globe Trotter' of the *Sydney Stock and Station Journal*, the TMAG was described as 'a gem'. 'It possesses one of the most delightful rooms that I ever came across ... "The Tasmanian Room".' Globe Trotter enthused 'You see almost at a glance what Tasmania can produce from coal to gold, from snails to sharks, from aboriginals' skulls to the Tasmanian devil. If any man will walk through that room with his eyes open he will see that there is a mighty future before Tasmania'. The room 'was the sight of the island because it grouped all the facts of island history in a picturesque manner, and showed the stranger what the country was capable of'.[197] Dr G. Boehm, Professor of Geology and Palaeontology at the University of Freiburg, Germany, was also impressed with the Tasmanian Room: 'Coming from New Zealand where it is simply impossible to get in the museum any idea of the historical geology of the country, this room seemed to me to be an oasis after a large desert.'[198]

The remarkable public support Morton enjoyed over the years can be largely attributed to the sound relationship he developed with the press, particularly the *Mercury*, ensuring regular promotion of the museum. The *Mercury* had long been a supporter of the Royal Society, publishing reports of their meetings. In 1884, at his first meeting with the council, Morton suggested the occasional insertion of an advertisement in the *Mercury* to promote the museum.[199] Brothers Charles and George Davies, who took over the proprietorship of the *Mercury* from their father John Davies in 1871, were elected members of the Royal Society in 1884. At the annual general meeting in 1885, Morton proposed 'a vote of thanks to the press, and especially to the *Mercury*, for the valuable assistance rendered in the reporting of their proceedings in a way which was far beyond the ordinary course of business'.[200] Morton capitalised on this relationship for the museum, never missing the opportunity to promote donations, exhibitions and special events. He also utilised the press for political reasons, for example, when lobbying to prevent the Braddon government from reducing the vote to the museum and gardens in 1895.[201]

Morton also commissioned Beattie to take a series of high quality photographs of the galleries in 1895 and again in 1902 for publication in the *Tasmanian Mail.*

The *Tasmanian News* was also generally supportive. In an editorial published in 1898 the museum was described as 'One of the most useful institutions in the City … and one which has gained more than a local celebrity, due in a great measure to the increasing labours and energy of the Curator'.[202] Morton's relationship with the *Clipper* was less smooth, though the journal provided him with a fine obituary[203] and generally praised his work at the museum. It was less complimentary about his involvement in community organisations where he was considered to have little expertise. In 1900, for example, the *Clipper* claimed that as a curator 'no critic's spleen can touch him',[204] though the following year he was criticised for meddling in the Industrial Exhibition Awards and described as a 'permanent and most atrocious nuisance'.[205] Morton was 'a model curator', but 'must cease to worry about things that do not specially concern him'.[206]

Caroline Morton contributed numerous press articles promoting the interests of the museum and Royal Society. She was a prolific writer, producing several works with historical and tourist themes.[207] Examples of her articles are included in Morton's scrapbooks covering a wide range of topics including the museum, mining, an expedition to New Guinea and the introduction of Salmonidae to Tasmania.[208] Caroline Morton also provided commentary on the 1885 museum and gardens legislation, as previously mentioned, and the government's attempt to reduce the vote in 1895.[209] She regularly wrote articles about the activities of the Royal Society;[210] Agnew acknowledging her 'appreciative review of the work of the Session' in 1888.[211] Articles relating to the TMAG and Royal Society were normally published under a pseudonym, presumably to conceal her identity both as Morton's wife and as a woman often writing about 'masculine' subjects.

Conclusion

A.G. Webster, who served as a trustee throughout the entire period of Morton's office, and from 1904 as chairman, was prepared to give Morton most of the credit for the major achievements of the museum during the period. In his tribute to Morton in 1907, Webster credited him with being largely responsible for the establishment of the art gallery, the two additions to the museum building, the large expansion of the collections, and entirely for the celebrated order and arrangement of the specimens.[212] Notwithstanding the early efforts of Agnew and Douglas, who were responsible for the success of the 1885 Act in Parliament, and for approving the funds for the first building extension, this assessment is fair.

Recognition of Morton's achievements should not discount the support provided by members of the council, particularly Agnew, who, together with Joseph Milligan was instrumental in the development of the early Royal Society Museum. Other contributors included R.M. Johnston who acted as honorary curator on occasions and was described by Hamilton in 1892 as 'the mainstay of our Society' and a man of 'genius, versatility, and untiring industry in the cause of science'.[213] The work of caretaker John Arnold, although not reflected in official records, is likely to have been considerable.[214] The Royal Society's desire to develop the museum was given far greater impetus with Morton's arrival and, while he was not the only factor in the success of the period, his role and skills were decisive in raising the importance of the museum between 1884 and 1907.

Perhaps the final assessment of Morton should be left to the *Clipper*. The journal was radical and outspoken, and, although Morton was criticised on occasions, as a curator he was admired. In 1907 the *Clipper* remembered him as a friend of the worker and 'a man of exceptional attainments' with 'splendid canvassing ability'. Morton's 'apparent sycophantic veneer was deliberately assumed for his purpose, and beneath it all was an intense and practical sympathy for humanity and a strong desire to promote healthier standards of public life and progress ...'.[215] In a conservative, financially restrictive environment, his approach to the development of a museum for the people was outstandingly successful, though his 'extraordinary and skilled exertions' came at a considerable personal cost. In 1900, the *Clipper* summarised Morton's contribution to the museum in the following way:

> When he came to Hobart, the Museum was in a simply chaotic condition: a mere dusty jumble, everything mixed up higgledy-piggledy, valuable specimens with useless rubbish; and as to the Art Gallery — well there simply was no Art Gallery. Morton has cleaned and garnished, beautified and greatly extended the Museum, and he has made the Art Gallery. He is not a scientist, in the special sense; but he has a full endowment of that keen enthusiasm for nature, which is the best quality of all successful curators. He is infinitely more useful in his position than any mere bug and beetle pedant could be. And since he is indefatigable and resolutely self-sacrificing in the pursuit of his duties, it will be seen that the Tasmanian public is greatly in his debt ...'.[216]

That was a fitting epitaph.

Endnotes

1 S Sheets-Pyenson, *Cathedrals of Science: The Development of Colonial Natural History Museums during the Late Nineteenth Century*, McGill – Queen's University Press, Kingston, 1988, pp. 25–26. For the development of Australian natural history museums in the nineteenth century, see SG Kohlstedt, 'Australian Museums of Natural History: Public Priorities and Scientific Initiatives in the Nineteenth Century', *Historical Records of Australian Science*, vol. 5, Australian Academy of Science, Canberra, 1983, pp. 1–29.

2 See comments later in paper.

3 Tasmanian Museum and Art Gallery (TMAG) Trustee minutes vol. 2, 7 June 1907, p. 20.

4 *Clipper*, 1 June 1907.

5 J Somerville, 'The Royal Society of Tasmania, 1843–1943', *Papers and Proceedings of The Royal Society of Tasmania*, 1943, p. 218.

6 G Winter, 'For the Advancement of Science: the Royal Society of Tasmania, 1843–1885', unpublished BA (Hons) thesis, University of Tasmania, 1972, p. 82; TMAG, P Mercer's unpublished history: *A Short History of the Tasmanian Museum and Art Gallery*, 1999, pp. 5–8; P Mercer, 'Alexander Morton (1854–1907)', *Australian Dictionary of Biography*, vol. 10, pp. 597–598.

7 P Mercer, 'The Tasmanian International Exhibition, 1894–95: An Ephemeral Event, or a Lasting Legacy?' in *The Exhibition Exhibition: A Centenary Celebration of the International Exhibition, 1894–1895*, TMAG, Hobart, 1994, pp. 7–20.

8 S Petrow, *Going to the Mechanics: A History of the Launceston Mechanics' Institute 1842–1914*, Historical Survey of Northern Tasmania, Launceston, 1998, pp. 113–116. Vicki Pearce also documented aspects of Morton's curatorial work in the research she undertook for the TMAG history project in the mid-1980s.

9 EL Piesse, 'The foundation and early work of the Society; with some account of earlier institutions and societies in Tasmania', *Papers and Proceedings of the Royal Society of Tasmania*, 1913, p. 153; Somerville, 'The Royal Society of Tasmania, 1843–1943', p. 199; TMAG, Mercer's unpublished history, p. 3. Morton's predecessors were George Whiting (1861–1862) and Thomas Roblin (1862–1883). Please note that following references to the 'Royal Society' refer to the Tasmanian body.

10 University of Tasmania Archives (UTA), Royal Society of Tasmania (RST) minutes, November 1884. Morton was elected a fellow on 13 October 1884.

11 Morton was elected a fellow of the Linnean Society on the recommendation of Baron Ferdinand von Mueller. See L Robson, *A History of Tasmania: Colony and State from 1856 to the 1980s*, vol. 2, Oxford University Press, Melbourne, 1991, p. 77. See also TMAG Morton scrapbook 1884–1895, p. 11 (letter from Linnean Society, London to Morton, 21 February 1889).

12 RST, 'In Memoriam. The Late Mr Alex Morton', *Papers and Proceedings of the Royal Society of Tasmania*, 1906–1907, p. xlvii. See Appendix B for a list of Morton's publications.

13 *Report of the Second Meeting of the Australasian Association for the Advancement of Science*, Australasian Association for the Advancement of Science, Melbourne,1891, p. xii.

14 Petrow, *Going to the Mechanics*, p. 115; Mercer, 'Alexander Morton', pp. 597–598. Morton was executive commissioner for Tasmania at the Melbourne International Centennial Exhibition, 1888–1889, and honorary secretary of the Tasmanian section of the Paris Exposition Universelle in 1889. He was director of the executive management committee of the Tasmanian International Exhibition, Hobart, 1894–1895, and a commissioner of Fisheries for Tasmania. Morton's interests ranged widely and he sat on a number of boards and committees during his career, including the Technical Board of Hobart, Tasmanian Improvement and Tourist Association, Hobart Horticultural Society, Domain Committee, Queen's Diamond Jubilee Committee in 1897, and Unemployed Relief Committee in 1894. He was also a founding member of the Geographical Society of Australasia, and one of the oldest members of the Southern Tasmanian Agricultural Society.

15 The material in this paper has been taken from the author's unpublished BA (Hons) thesis: 'Curatorial zeal: the contribution of Alexander Morton to the Tasmanian Museum and Art Gallery, 1884–1907'. University of Tasmania, Hobart, 2002.

16 C Healy, *From the Ruins of Colonialism: History as Social Memory*, Cambridge University Press, Cambridge, 1997, chapter 3.

17 Mercer, 'Alexander Morton', p. 597; *Cyclopedia of Tasmania*, vol. 1, Maitland and Krane, Hobart, 1900, p. 312–313; Australian Museum (AM), GP Whitley's unpublished history of the Australian Museum, vol. 1, chap. 8, p. 25; RST, 'In Memoriam. The Late Mr Alex Morton', p. xlvii.

18 AM Trustee minutes, 3 May 1877, p. 257; 15 January 1880, p. 39; 10 September 1880, p. 139; AM letters received, 15 January 1883, letter 24; AM letters sent, 18 January 1883, letter 406.

19 Mercer, 'Alexander Morton', p. 597; R Strahan, *Rare and Curious Specimens: An Illustrated History of the Australian Museum*, The Australian Museum, Sydney, 1977, p. 136.

20 AM Whitley's unpublished history, p. 25; Mercer, 'Alexander Morton', p. 597; Strahan, *Rare and Curious*, p. 136.

21 TMAG Morton diary, Australian Museum, 1883. The diary is only filled in for March; however, it provides a number of insights into Morton's relationship with Ramsay; his enthusiasm, devotion to work and interest in all aspects of the museum.

22 UTA RST minutes, 28 December 1883, p. 126; 25 January 1884, p. 129.

23 *Mercury*, 30 January 1884. Testimonial probably provided by curator of the Australian Museum, EP Ramsay. Sir Alfred Stephen, crown trustee and lieutenant-governor, also provided Morton with a letter of introduction to a number of his friends and acquaintances in Hobart, including the secretary to the governor, the premier, and James Agnew. He described Morton as 'a most able, zealous, and valuable public servant, respected by all of us, the Museum Trustees, and as one whom we are sorry to lose'. See TMAG Morton scrapbook 1884–1895 (letter from Stephen to Morton, 26 February 1884).

24 UTA RST minutes, 25 January 1884, p. 129. The grant-in-aid to the museum was only £200 in 1884.

25 The curator of the Australian Museum, for example, earned £600 plus an allowance of £100 in 1884. The curator of the Queensland Museum earned £400 in 1884, though this was reduced during the economic depression of the 1890s. Information obtained from annual reports. Morton was also to receive £25 for each of his secretary positions, bringing his total salary to £275 plus a house. His salary did not increase until 1905.

26 AM minutes, 10 September 1880; AM letters sent, 18 January 1883, letter 406.

27 RST reports 1879–1883.

28 UTA RST minutes, 26 February 1884, p. 131.

29 FC Green, 'Sir James Wilson Agnew (1815–1901)', *Australian Dictionary of Biography*, vol. 13, pp. 18–19.

30 See Winter, 'For the Advancement of Science' for Agnew's earlier involvement in the society and museum.

31 L Robson, M Roe, *A Short History of Tasmania*, Oxford University Press, Melbourne, 1997, pp. 49–50; Robson, *History of Tasmania*, pp. 143–144.

32 Robson and Roe, *Short History of Tasmania*, p. 50.

33 Robson, *History of Tasmania*, p. 116.

34 *Mercury*, 28 October 1885; G Davison (ed.), *The Oxford Companion to Australian History*, Oxford University Press, Melbourne, 1998, pp. 446–447; Kohlstedt, 'Australian Museums of Natural History', p. 18.

35 Until 1885 the annual government grant remained at £200 for the museum. The council succeeded in negotiating an increase for 1885 to £300, however the level of funding was not guaranteed. See UTA RST annual reports 1879–1885.

36 UTA RST minutes 25 January 1884, p. 29; 11 March 1884, p. 133; 11 August 1884, p. 150; RST outward letters RSA/B/2 (from Hon. Sec. Agnew, to Treasurer, 22 July 1884).

37 The RST report for 1884 praises the joint efforts of Agnew and Morton in revitalising the society during the year. Winter, in her thesis 'For the Advancement of Science', p. 63, contends that the society had become less active from January 1881 to January 1884, while Agnew was overseas.

38 *Tasmanian Mail*, 17 August 1895.

39 RST report 1884, p. 4.

40 UTA RST, RSA/B/2 letter book, outward letters January 1874–September 1885, pp. 467–468 (Agnew to Douglas, 26 May 1885); p. 470 (Agnew to Douglas, 10 June 1885).

41 *Mercury*, 28 July 1885; UTA RST minutes 28 July 1885, pp. 179–180.

42 *Mercury*, 28 July 1885.

43 *Ibid*.

44 Agnew and Douglas originally met in the Port Phillip district 'and since then, some 61 years, the closest friendship has existed between the two'. See *Tasmanian Mail*, 16 November 1901. See also *Mercury*, 28 October 1885 for debate about the bill. The House of Assembly, although being generally in favour of the legislation, was unhappy with a clause giving Trustees the power to alienate land with the consent of the executive, and sought an amendment requiring reference to parliament. Given that parliament met infrequently, this amendment had the potential to disadvantage Trustees in the case of minor property donations, only of value if the land could be sold. The ensuing debate threatened to defeat the bill; Agnew secured Douglas's support in the Legislative Council to successfully argue against this amendment. Two further amendments were passed. The number of Royal Society Trustee representatives was reduced from twelve to six, to prevent the society from having 'undue influence'. The proposed quorum of four was changed to five. This last amendment was to cause the board considerable difficulty in future years, with meetings regularly lapsing due to insufficient numbers to form a quorum.

45 TMAG minutes, vol. 1, p. 159 (newspaper clipping, *Mercury*, 23 October 1885, pasted into minute book, and marked 'Dio' in Morton's handwriting).

46 When the Royal Society Museum formally became the Tasmanian Museum. See *An Act to incorporate and endow the Tasmanian Museum and Botanical Gardens, 49° Victoria, No. 34, 5 December 1885*. See also 'By-Laws and General Rules of the Tasmanian Museum and the Botanical Gardens', in *Hobart Gazette*, 16 March 1886. These were based on the 1853 act, by-laws and rules of the Australian Museum.

47 The new twelve-member board included five official Trustees: the Chief Justice, Chief Secretary, Minister of Lands and Works, President of the Legislative Council and Speaker of the House of Assembly. The Governor appointed one crown Trustee. The remaining six elective Trustees were chosen from the Royal Society council. In 1926 the act was repealed, removing the official appointments.

48 The contribution of official Trustee Nicholas Brown was also noted when he died in 1903, Webster stating that 'for 18 years [he] was an active member of the Board, at all times taking a very keen interest in both institutions'. See TMAG annual report 1903, p. 1.

49 In January 1886, Council elected the following six members as Trustees: Agnew became first chairman of the board, continuing in that role until his death in 1901. James Barnard was appointed as the first government printer for Van Diemen's Land in 1838, occupying the position until his retirement in 1880. AG Webster was a successful agricultural merchant. CH Grant was an engineer, prosperous businessman and member of the Legislative Council from 1892 to 1901. Russell Young was a solicitor of the Supreme Court of Tasmania. Justin Browne was a well-known Hobart merchant.

Crown Trustee, Matthew Seal, was chairman of the Fisheries Board of Tasmania. When he died in 1897, Webster was appointed to the position. Government statistician, registrar general, and scientist, RM Johnston, replaced Webster as elective Trustee. See Appendix A for a complete list of elective and crown Trustees serving between 1886 and 1907.

50 RST report 1884, p. 4.

51 UTA RST minutes of annual general meeting, 26 January 1885, in RST annual report 1884.

52 TMAG Morton scrapbook 1884–1895 (letter from Hamilton to Morton, 28 November 1892).
See also AJ Harrison, *Savant of the Australian Seas. William Saville-Kent (1845–1908) and Australian Fisheries*, Tasmanian Historical Research Association, Hobart, 1997, pp. 69–74. Harrison discusses establishment interests in the fisheries, particularly those of Hamilton and Agnew in terms of their support of salmon acclimatisation. He describes Morton as one of the principal 'players' in the fisheries scene.

53 Strahan, *Rare and Curious Specimens*, pp. 27–38.

54 Archives Office of Tasmania (AOT), Chief Secretary's Department (CSD) 22/104/56, Correspondence 1907 (C. Morton to Chief Secretary, 15 October 1907).

55 Strahan, *Rare and Curious Specimens*, pp. 46–50.

56 TMAG minutes, vol. 1, 21 December 1903, p.290.

57 *Ibid.*, 25 November 1903, p. 284.

58 *Ibid.*, 25 November 1903, pp. 284–286.

59 *Ibid.*, 16 November 1904, pp. 308–310.

60 *Ibid.*, 25 November 1904, pp. 312–314.

61 *Ibid.*, 21 November 1904, p. 311; 25 November 1904, pp. 312–314; 1 December 1904, pp. 315–316; 23 February 1905, p. 318.

62 TMAG Morton-Hall letter book 1904–1910, p. 27 (Webster to Rodway, 25 November 1904).

63 TMAG minutes, vol. 1, 23 February 1905, p. 318.

64 AOT, CSD 22/104/ 56, Correspondence 1907 (Rodway to Premier, 28 September, 1907).

65 *Ibid.*, Correspondence 1907 (Rodway to Under-Secretary, October 1907).

66 *Ibid.*, Correspondence 1907 (Webster to Chief Secretary, 13 November 1907).

67 The expenditure is slightly under the £800 vote in 1904 and 1906, in several other years, however, it is recorded as being over that amount.

68 AOT, CSD 22/104/56, Correspondence 1907 (Rodway to Chief Secretary, 21 November 1907).

69 TMAG Morton letter book 1893–1903, p. 425 (Morton to Abbott, 12 March, 1903); TMAG reports 1903–1904.

70 TMAG report 1903; Morton letter book 1893–1903, p. 425 (Morton to Abbott, 12 March, 1903).

71 TMAG minutes, vol. 1, 1 December 1903, pp. 288–289.

72 *Ibid.*, 7 October 1886, p. 17; 5 May 1887, p. 23; 24 August 1888, pp. 33–34.

73 Ann Elias, 'Leonard Rodway (1853–1936)', *Australian Dictionary of Biography*, vol. 11, p. 437.
In 1928, Rodway was appointed director of the Botanical Gardens at £25 per annum, and director of the new herbarium at £50 per annum. See TMAG minutes, vol. 5, 1 November 1928, p. 14; and 3 December 1928, p. 15.

74 TMAG report 1897, p. 3. In comparison, the government vote for the Australian Museum in 1884 was £7550, 1907–1908: £7931; National Museum of Victoria 1883–1884: £1385, 1906–1907: £2320; Queensland Museum 1882–1883: £1096; expenditure at the South Australian Museum 1884–1885: £1640, 1907–1908: £1899. Information obtained from annual reports.

75 *Mercury*, 25 July and 14 August 1895.

76 C Rasmussen, *A Museum for the People: A history of Museum Victoria and its predecessors, 1854–2000*, Scribe Publications, Melbourne, 2001, p. 63.

77 TMAG report 1891, p. 3.

78 *Mercury*, 22 May 1889. In this year Trustees of the Art Gallery of New South Wales set aside a sum of £500 'to induce the production of some really good colonial pictures': the same amount as that provided for the yearly maintenance of the TMAG.

79 TMAG report 1904, p. 2. Estate of Sir Richard and Lady Clara Dry.

80 TMAG Morton-Hall letter book 1904–1910, pp. 43–44 (Morton to Premier Evans, 6 May 1905).

81 TMAG museum history files compiled by Vicki Pearce. (Copy of letter from Morton to Bailey, 8 June 1905, with copy of his application to the Queensland Department of Agriculture and Stock.)

82 Patricia Mather, *A Time for a Museum: The History of the Queensland Museum 1862–1986*, Queensland Museum, Queensland, 1986, pp. 50–52.

83 TMAG minutes, vol. 2, 31 May 1907, p. 19; Morton-Hall letter book 1904–1910, p. 87 (letter from Webster to Caroline Morton 31 May 1907); UTA RST minutes, 31 May 1907, p. 107.

84 TMAG minutes, vol. 2, 7 June 1907, p. 20.

85 *Ibid.*, 9 July 1907, p. 22.

86 *Ibid.*, 23 July 1907, p. 23; 23 December 1907, p. 29. The Trustees sought to reward her contribution by 'waiting on' the premier to achieve a gratuity, bringing the total of her salary for seven months to £151.12, the amount of retiring allowance she would have been entitled to if Morton had been a civil servant. Caroline Morton accepted employment as secretary partly from necessity. The *Tasmanian Mail* reported on 8 June 1907 that 'she had no private means whatever, although some people thought she had'.

87 TMAG, Mercer's unpublished history, pp. 4–5.

88 Freeman Collett Tasmania, *The Royal Society & Tasmanian Museum Buildings, Tasmanian Museum and Art Gallery, Hobart, Conservation Management Plan*, vol. 1, TMAG, Hobart, 1995, pp. 6, 8, 47; B Shelton, *Henry Hunter Architect Hobart Town*, TMAG, Hobart, 1982, p. 5.

89 TMAG, Mercer's unpublished history, pp. 4–5; Piesse, 'The Foundation and early work of the Society', p. 156; TMAG Royal Society/Seabrook Building Contract, R150.

90 TMAG report 1886, p. 3.
91 *Mercury*, 24 December 1886.
92 AOT, PWD 18/1/882, item 933.
93 *Mercury*, 15 March 1889.
94 TMAG minutes, vol. 1, March 1889, pp. 41–42; 2 May 1889, pp. 42–43.
95 *Mercury*, 22 May 1889.
96 AOT, CSD 16/17/113, Correspondence 1891 (letter from Morton to Chief Secretary, 16 June 1891). A note on the reverse of the letter confirms that a government official was sent to inspect the museum. 'I have examined the building and collections and concur fully in Mr Morton's remarks and would recommend the erection of new wing asked for.' Fysh was a member of the society and had earlier demonstrated his support when in 1885 he formed a committee with Agnew and Douglas in the Legislative Council to oppose the House of Assembly's amendment of the museum and gardens bill.
97 TMAG minutes, vol. 1, 21 July 1891, p. 79.
98 TMAG Morton letter book 1893–1903, p. 337; TMAG minutes, vol. 1, 3 July 1900, p. 231.
99 *Mercury*, 30 August 1900.
100 *Ibid.*, 7 November 1900.
101 TMAG minutes, vol. 1, 11 December 1900, p. 234.
102 *Mercury*, 5 May 1902; AOT, PWD 18/1/4358, item 4745
103 *Mercury*, 21 March 1901.
104 TMAG minutes, vol. 1, 28 April 1902, p. 252.
105 *Mercury*, 5 May 1902.
106 *Ibid.*, 30 April 1902.
107 *Ibid.*
108 TMAG Morton letter book 1893–1903, p. 349 (Morton to Tasmanian mining companies, 28 November 1900).
109 TMAG report 1902, p. 1.
110 *Mercury*, 30 April 1902.
111 TMAG minutes vol. 1, 12 July 1898, pp. 199–200.
112 Robson, *History of Tasmania*, pp. 285–286; Mercer, 'Alexander Morton', p. 598.
113 RST report 1883, p. 4.
114 *Mercury*, 5 April 1877.
115 *Ibid.*, 6 April 1877.
116 TMAG Morton scrapbook, 1884–1895 (testimonial from Moore to Morton, 20 July 1895).
117 *Clipper*, 1 September 1900.
118 RST report 1884, p. 4.
119 *Mercury*, 15 July 1885.
120 *Ibid.*, 22 May 1889.
121 TMAG report 1886, p. 3.
122 *Ibid.*, 1887, p. 3.
123 TMAG Morton letter book 1893–1903, p. 200 (Morton to R Teece, Australian Mutual Provident Society, Sydney, 24 June 1896).
124 TMAG reports 1886, p. 3; 1889, p. 3; 1895, p. 3.
125 *Mercury*, 15 July 1885.
126 TMAG report 1893, p. 3.
127 *Ibid.*, 1902, p. 1.
128 For further discussion see Healy, *From the Ruins of Colonialism*, pp. 86–88.
129 *Ibid.*, p. 96.
130 This decision reversed an earlier agreement between the Royal Society and the government not to place Truganini's skeleton on public display. The skeleton remained on display until 1947. See J Cove, *What the Bones Say. Tasmanian Aborigines, Science and Domination*, Carlton University Press, Canada, 1995, pp. 51–52. See also Lyndall Ryan, *The Aboriginal Tasmanians*, 2nd ed., Allen and Unwin, St Leonards, 1996, pp. 219–220.
131 *Mercury*, 21 May 1889; TMAG reports 1888, p. 3, and 1893, p. 3.
132 Morton was invited by the president of the Bathurst Federation League to attend the People's Federal Convention held in November 1896. See TMAG Morton scrapbook 1892–1906. Morton's scrapbook for 1894–1898 also contains numerous newspaper clippings relating to the federal debates.
133 PT McKay and FC Green, 'Sir Adye Douglas (1815–1906)', *Australian Dictionary of Biography*, vol. 4, p. 88; Robson, *History of Tasmania*, pp. 199–200.
134 *Mercury*, 21 May 1889.
135 *Ibid.*, 15 July 1885.
136 TMAG minutes, vol. 1, 30 October 1894, p. 145.
137 TMAG minute notebook: Morton 1892–1899, 24 February 1898, p. 49. See also M Roe, *The State of Tasmania: Identity at Federation Time*, Tasmanian Historical Research Association, Hobart, 2001.
138 *Ibid.* Morton was also secretary of the Historical and Geographical Section of the Royal Society of Tasmania, established in 1899. See S Petrow, 'The Antiquarian Mind: Tasmanian History and the Royal Society of Tasmania 1899–1927', *Papers and Proceedings of the Royal Society of Tasmania*, vol. 137, 2003, p. 68.
139 RST reports 1884–1885, p. 4, and TMAG reports from 1886.
140 Strahan, *Rare and Curious Specimens*, p. 136. Other museums utilised Morton's collecting skills. In 1897 the Western Australian Museum paid for Morton to undertake a three-month collecting expedition in Western Australia, with the understanding that one-third of the material would come to the TMAG. Substantial collections of zoological, mineralogical and ethnological specimens were made in the Upper Murchison region. See TMAG report 1897.

141 *Ibid.*, pp. 38–39.

142 *Mercury*, 4 February 1896; TMAG report 1893, p. 3.

143 TMAG minutes, vol. 1, 3 September 1891, p. 87.

144 *Tasmanian News*, 19 April 1897. Presented by Mr J Harrold.

145 TMAG report 1899, p. 3. Presented by Mr HM Courage.

146 William Henry Flower, *Essays on Museums and Other Subjects Connected with Natural History*, Macmillan, London, 1898, pp. 18–21. Flower's 1889 address to the British Association for the Advancement of Science is reproduced in this publication.

147 TMAG Morton scrapbook 1884–1895 (letter from Flower to Morton, 17 December 1889).

148 Sheets-Pyenson, *Cathedrals of Science*, pp. 5–8; Flower, *Essays on Museums*, pp. 37¬53.

149 Rasmussen, *A Museum for the People*, pp. 128–129. In 1891 Morton joined McCoy, Spencer, Ramsay, de Vis, WA Haswell, Dr Stirling and other interested members of the Australasian Association for the Advancement of Science to form a committee 'Appointed to consider and report upon the Improvement of Museums as a Means of Popular Instruction'. See *Report of the Third Meeting of the Australasian Association for the Advancement of Science*, Australasian Association for the Advancement of Science, New Zealand, 1892, pp. 538–539.

150 FA Bather, 'Some Colonial Museums', Museums Association, *Report of Proceedings ... 1894 ... in Dublin*, Museums Association, London, 1895, pp. 193–239.

151 *Ibid.*, pp. 196–198

152 *Ibid.*, pp. 198–199. The University of Tasmania had some common membership in its governing body with that of the TMAG. Agnew, Douglas and Johnston each served periods on the University Council.

153 TMAG minutes, vol. 1, 5 November 1895, p. 168. The TMAG does not possess earlier photographs of the museum interior.

154 *Mercury*, 24 December 1886.

155 *Ibid.*, 22 May 1889.

156 *Ibid.*, 21 May 1889.

157 *Ibid.* Watercolour of a Tasmanian forest scene at Deep Creek, loaned by Attorney-General AI Clark; two monochromes of Lake St Clair and Eldon Bluff, Lake Augusta, loaned by CE Walch; painting of Frenchmans Cap loaned by RM Johnston.

158 TMAG report 1892. Agnew had assisted Piguenit by inducing the government to purchase several of the artist's works when he was premier. See Robson, *History of Tasmania*, p. 167.

159 TMAG report 1888, p. 3. Presented by the Tasmanian Government.

160 *Mercury*, 21 May 1889.

161 TMAG report 1889, p. 3.

162 TMAG reports 1888–1904, and minutes, vol. 1. These included E Meissonier, ER Franz, EJ Poynter, EM Wimperis, Landelle, David Cox, Samuel Howitt and Walter Severn. Substantial donors included Miss Ada Wilson and Miss Wilson. In the report for 1899, the pictures presented to the TMAG by the Wilson sisters were valued at £3000. CJ Barclay, managing director of the Commercial Bank of Tasmania and Lady Dry were also substantial donors. Agnew presented a number of works, most notably a life-size statue of Medusa, made from Carrara marble by sculptor Franklin Simmons, valued at 1500 guineas. Other donors included Sir Lambert Dobson, Montagu Rhys-Jones and Sir Francis Smith. Among the lenders of valuable pictures were: JW Agnew, CJ Barclay, RM Johnston, JHB Walch, J Rushton, Montagu Rhys-Jones, CE Madam Lucien Henry, the Hons. GT Collins and Adye Douglas, and Lord Brassey, Governor of Victoria.

163 TMAG Morton scrapbook 1894–1898, p. 154 (*Tasmanian News*, 14 December 1896).

164 TMAG minutes, vol. 1, 7 July 1897, p. 191.

165 *Ibid.*, 6 December 1888, p. 38; 19 November 1889, p. 53; 5 December 1892, p. 111; *Mercury*, 15 March 1889.

166 TMAG minutes, vol. 1, 5 September 1889, p. 50; 5 June 1890, p. 60; 3 July 1890, p. 61.

167 TMAG report 1887, p. 3.

168 TMAG minutes, vol. 1, 7 May 1895, p. 151. *Mercury*, 15 June 1895.

169 Morton was involved with the Unemployed Relief Committee which carried out the renovations, with a local architect and contractor agreeing to supervise the work free of charge. The windows were covered over and glass skylights inserted in the roof to provide additional wall space. The work was completed in July 1894. See TMAG minutes, vol. 1, 20 June 1894, p. 140 and 3 July 1894, pp. 141–142; TMAG Morton scrapbook 1894–1898, p. 32a; TMAG report 1895.

170 TMAG report 1895, p. 3.

171 TMAG Morton letter book 1893–1903, p. 200 (Morton to R Teece, AMP Society, Sydney, 24 June 1896). Similar letters were sent to the British Life Insurance Company and the Equitable Life Assurance Society in Sydney.

172 TMAG Morton scrapbook 1894–1898, p. 82 (*Mercury*, 7 December 1895).

173 The loan paintings are listed in TMAG minutes vol. 1, pp. 153–154. At least five of these works remain in the collection. The artists donated four. The Wilson sisters presented four other paintings to the TMAG in 1895, and it is possible that others on display at the exhibition were purchased by members of the public and later donated. See further comments about Morton's involvement in Mercer, *The Exhibition Exhibition*.

174 TMAG, Morton-Hall letter book 1904–1910, pp. 90–91 (Webster to Premier Evans, 27 July 1907).

175 TMAG report 1904, p. 2.

176 TMAG reports 1886–1907.

177 UTA RST minutes, 5 May 1885, p. 171; TMAG minutes, vol. 1, 5 August 1886, p. 14.

178 TMAG minutes, vol. 1, 4 September 1894, p. 143; JM Bennett and FC Green, 'Sir Francis Villeneuve Smith (1819–1909)', *Australian Dictionary of Biography*, vol. 6, pp. 144–145.

179 *Mercury*, 14 June 1894.

180 TMAG report 1898, p. 4. Also noted in reports for 1899, 1901, 1902, 1903.

181 Winter, 'For the Advancement of Science', p. 69.

182 *Mercury*, 28 October 1885.

183 RST report 1885, p. 4.

184 TMAG report 1888, p. 3.

185 *Ibid.*, 1889, p. 3; 1894, p. 3; 1895, p.4; 1897, p.3; 1899, p. 4.

186 *Ibid.*, 1901, p. 2.

187 Roe, *The State of Tasmania*, p. 2. The total Tasmanian population was 172,475 in the 1901 census and Hobart had 24,654 people. The museum was closed on Mondays from 1898, unless large passenger steamers were in port. See TMAG reports 1898, p. 3, and 1906, p. 1.

188 TMAG report 1904, p. 2.

189 *Ibid.*, 1911–1912, p. 1.

190 *Ibid.*, 1886–1902. Numbers are not provided for 1903–1907.

191 Tasmanian Public Library report 1902, p. 2. Most reports only provide a yearly total.

192 *Mercury*, 2 June 1892. A similar letter was published in the *Mercury*, 19 March 1892, under the pseudonym 'Herbert Harless'.

193 *Ibid.*, 23 July 1895.

194 *Ibid.*, 31 July 1895.

195 Robson, *A History of Tasmania*, p. 77.

196 *Mercury*, 31 August 1895. Piguenit noted that the government grant in 1895 for the museum in Sydney was £5109, and the art gallery £5000.

197 TMAG Morton scrapbook 1894–1898, p. 157 (extract of article 'A Trip to Tasmania, Hobart and Launceston' by 'Globe Trotter' of the *Sydney Stock and Station Journal*, published in the *Mercury*, 10 February 1897).

198 TMAG minutes, vol. 1, 31 May 1900, p. 229 (letter from Boehm to TMAG, 22 March 1900).

199 RST minutes, 11 March 1884, pp. 134–5.

200 RST report 1884 (minutes of AGM, 26 January 1885), p. 15; P Boyer, 'Sir John George Davies (1846–1913)' and 'Charles Ellis Davies (1847–1921)', *Australian Dictionary of Biography*, vol. 8, pp. 233–235.

201 TMAG minutes vol. 1, 1 July 1895, p. 158 (newspaper clipping, *Tasmanian News*, 12 July 1895, pasted into the minutes and initialled 'AM' in Morton's handwriting).

202 *Tasmanian News*, 28 September, 1898.

203 *Clipper*, 1 June 1907.

204 *Ibid.*, 1 September 1900.

205 *Ibid.*, 16 March 1901.

206 *Ibid.*, 23 March 1901.

207 Roe, *The State of Tasmania*, pp. 239, 243; A Alexander, *A Mortal Flame: Marie Bjelke Petersen, Australian Romance Writer 1874–1969*, Blubber Head Press, Hobart,1994, pp. 24–30.

208 TMAG Morton scrapbook 1886–1893, pp. 8–13 (newspaper clippings from the *Mercury*, 1886–1887, marked 'Dio' in Morton's handwriting).

209 TMAG minutes vol. 1, 1 July 1895, p. 158 (newspaper clipping, *Mercury*, 15 July 1895, pasted into the minutes and marked 'Dio' in Morton's handwriting).

210 TMAG Morton scrapbook 1886–1893, pp. 3–7 (newspaper clippings from the *Mercury*, 1886–1887, marked 'Dio' in Morton's handwriting).

211 UTA RST, RSA/B/8 (letter from Agnew to Morton). Agnew refers to the donation he has made to assist the introduction of salmon to Tasmania and the fact that his donation has been acknowledged in the House of Assembly. The acknowledgement occurred in 1888. See GD Brown, 'The Centenary of the death of the "Father of the Club", The Hon. James Wilson Agnew KCMG, 2 October 1815 – 8 November 1901', in *Tasmanian Club Newsletter* (October, 2001).

212 TMAG minutes vol. 2, 7 June 1907, p. 20; TMAG Morton-Hall letter book 1904–1910, pp. 90–91 (Webster to Premier Evans, 27 July 1907, applying for Caroline Morton's gratuity.)

213 *Report of the Fourth Meeting of the Australasian Association for the Advancement of Science*, Australasian Association for the Advancement of Science, Hobart, 1893, p. 20 (Hamilton's address to the meeting held in Hobart in January 1892.)

214 Arnold continued to work at the museum until 1929. On his retirement, following forty-five years of service, he offered Trustees a substantial cash donation of £500. The funds were used to construct an Aboriginal diorama.

215 *Clipper*, 1 June 1907.

216 *Ibid.*, 1 September 1900.

APPENDICES

Appendix A:
TASMANIAN MUSEUM AND BOTANICAL GARDENS TRUSTEES 1886–1907

Chairmen
Sir James Wilson Agnew (1886–1901)
Sir Adye Douglas (1901–1904)
Alexander George Webster (1904–1910)

Elective Trustees
Sir J.W. Agnew
James Barnard
Charles Torrens Belstead
Dr Richard Stonehewer Bright
Justin McCarthy Browne
Charles Henry Grant
Robert Mackenzie Johnston
Colonel William Vincent Legge
Professor R. Neil-Smith
Bernard Shaw
Thomas Stephens
A.G. Webster
Russell Young

Crown Trustees
Mathew Seal (1886–1897)
A.G. Webster (1897–1910)

Appendix B:
ALEXANDER MORTON'S PUBLICATIONS

Morton A (1878?) *Notes of a trip to New Guinea.* (*Mercury*: Hobart)

Morton A (1882) Notes on a cruise to the Solomon Islands, *Proceedings of the Linnean Society of New South Wales.* Series 1, **7(1)**, 59.

Morton A (1882) 'Fauna [in] Lord Howe Island'. *Report on present state and future prospects of Lord Howe Island*, by the Hon. J Bowie Wilson to the Colonial Secretary. (Government Printer: Sydney)

Morton A (1883) Exploration of Burdekin and Mary Rivers, Queensland. Appendix to Australian Museum Annual Report for 1882. (Australian Museum: Sydney)

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UNIQUELY TASMANIAN – A REVIEW OF THE PHYLOGENETIC AND BIOGEOGRAPHICAL RELATIONSHIPS OF TASMANIA'S ENDEMIC VASCULAR PLANT GENERA

Andrew C. Rozefelds

Rozefelds, A.C. 2007. Uniquely Tasmanian – a review of the phylogenetic and biogeographical relationships of Tasmania's endemic vascular plant genera. *Kanunnah* 2: 35–86. ISSN 1832-536X. The endemic genera of Tasmania are a heterogenous assemblage of taxa, which are represented in families including Asteliaceae, Asteraceae, Campynemataceae, Cunoniaceae, Cupressaceae, Ericaceae, Haloragaceae *sensu lato* (including *Tetracarpaea*), Iridaceae, Malvaceae, Podocarpaceae, Proteaceae and Restionaceae. Two informal groupings of genera are recognised, one group consists of old relictual genera (palaeoendemics) and a second group are relatively recent segregates (neoendemics).

Palaeoendemics include the conifers, *Athrotaxis, Diselma, Lagarostrobos* and *Microcachrys*, and the flowering plants, *Agastachys, Anodopetalum, Bellendena, Campynema, Cenarrhenes, Isophysis, Milligania, Prionotes, Planocarpa* and *Tetracarpaea*. These genera are early offshoots in their respective clades and some are so phylogenetically isolated that their sister group relationships are only determinable at the subfamily level, and/or their closest relatives lie outside of Australia. Tasmania is therefore an extremely important refuge for a significant number of taxonomically isolated genera.

The palaeoendemics are largely restricted to the western half of Tasmania, which has an aseasonal-wet climate. This biome typically includes the rainforest genera, although some, like *Agastachys, Cenarrhenes* and *Milligania*, occur in a range of plant communities. With the possible exception of *Lagarostrobos* and *Microcachrys* there is no fossil evidence to indicate that these palaeoendemics have occurred outside of the state.

The neoendemics, *Asterotrichion, Odixia* and *Stonesiella*, are relatively recent segregates and occur in eastern Tasmania, often as undershrubs in *Eucalyptus* forests and they appear to have evolved in situ and in response to aridification of the Tasmanian climate from the Miocene onwards. The status of two endemics, *Winifredia* and *Pterygopappus*, is unclear.

Tasmania is interpreted to be a composite area, and the history of the taxa and their systematic and biogeographical relationships are complex. Overall the biogeographical relationships of Tasmania's endemic genera are gondwanic with approximately 48% having links to mainland Australia. More distant links are recognised with New Zealand (5%), New Caledonia (5%), southern Africa (5%) and South America (10%).

The biogeographical relationships of approximately 26% of the endemic genera, those taxa that are phylogenetically most isolated, cannot be currently resolved. These results suggest that our ability to identify congruence between different sets of taxa is inversely proportional to the age of the lineage being studied.

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KEY WORDS: Tasmania, Gondwana, endemic genera, palaeoendemic, neoendemic, conifers, *Athrotaxis*, *Lagarostrobos*, *Diselma*, *Microcachrys*, flowering plants, *Agastachys*, *Asterotrichion*, *Bellendena*, *Campynema*, *Cenarrhenes*, *Isophysis*, *Milligania*, *Odixia*, *Planocarpa*, *Pterygopappus*, *Prionotes*, *Stonesiella*, *Tetracarpaea*, *Winifredia*, Australia, New Zealand, southern Africa, South America, New Caledonia

The aim of this paper is to compile a list of the genera endemic to Tasmania, review their phylogenetic relationships and assess the utility and limitations of these studies in understanding the evolutionary history of the Tasmanian flora. The distribution of endemic species in Tasmania, which would also include the endemic genera, has been studied by Kirkpatrick and Brown (1984a, b). There has been, however, no previous attempt to review the phylogenetic and biogeographical relationships of the endemic genera in the state. The study also aims to determine what, if any, generalised patterns might exist between these genera in terms of geographical distribution, habit, altitude and associations with particular plant communities and habitats.

In this paper the phylogenetic and biogeographical relationships of each genus are discussed using both morphological and molecular-based data. The plant communities in which these genera occur have been described by Jarman *et al.* (1994) and Kirkpatrick *et al.* (1995). Information on the distribution, habitat and altitudinal range of these plants is from Tasmanian Herbarium (HO) records, literature sources and additional advice provided by Greg Jordan (University of Tasmania).

SCOPE AND PLANNING OF STUDY

Classification of endemics

Endemics have been classified into various systems in the past. Richardson (1978) developed a theoretical model to discuss species, which can also be applied to other taxonomic ranks. His model identified three types of endemic: neoendemics, holoendemics and palaeoendemics. This model, however, does have several limitations when applied to the present study. Some of the attributes used by Richardson (1978), e.g., 'polymorphism' to define types of endemics are more difficult to apply to genera. The variation within a genus with a

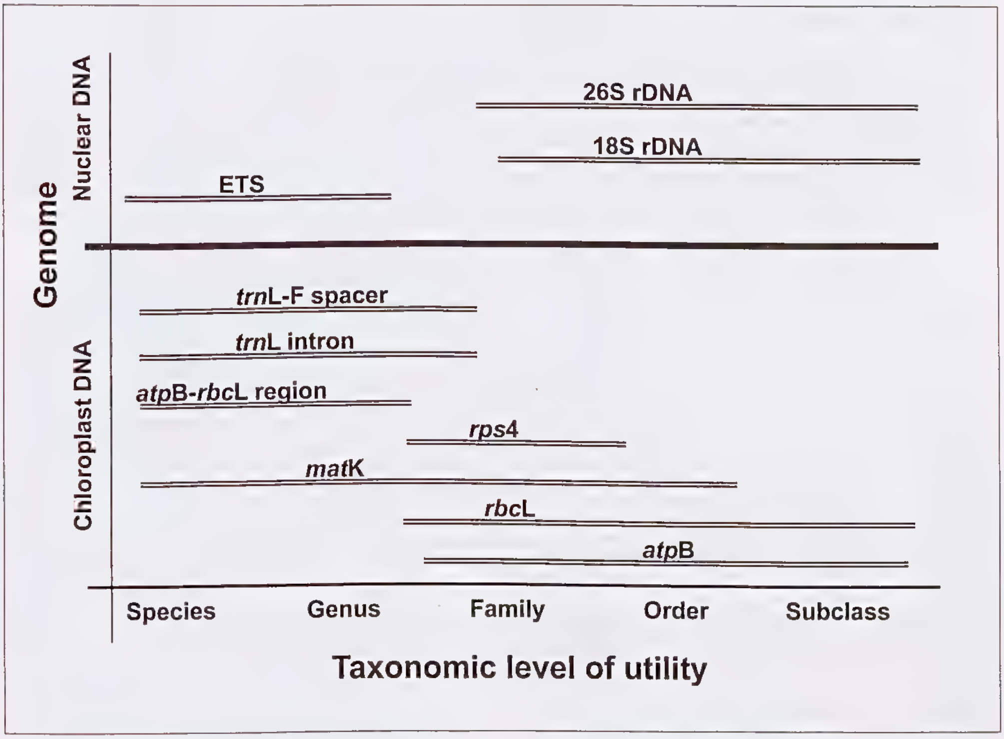


Fig. 1. Simplified diagram of the taxonomic level of utility of the various chloroplast and nuclear DNA regions that have been used to study the phylogenetic relationships of Tasmania's endemic conifer and angiosperm genera (adapted from Soltis and Soltis 1998).

number of species is likely to be greater than that which occurs in monotypic genera. Richardson's use of 'derived characters' as an attribute is also philosophically difficult to apply since all taxa should be defined by derived (apomorphic) characters. Richardson also used the degree of geographical isolation, although it could be argued that all endemic genera in Tasmania are 'geographically isolated' to some extent.

The approach taken here is (a) to review the phylogenetic relationships of each of the endemic genera and (b) to assess the degree of taxonomic isolation and the inferred age of each lineage through interpretation of sequence data, and where possible, by independent verification of the age of genera and sister taxa from the fossil record, or through estimates of age based upon vicariance. The level of utility of various chloroplast, nuclear and DNA regions for phylogenetic analysis provides a guide in interpreting the ages of the lineages being studied (Fig. 1). For example, analysis of sequence data from *rbc*L, *rps*4, *atp*B inter-spacer region, 26S rDNA, 18S rDNA is used to examine suprageneric taxonomic questions (Soltis and Soltis 1998; Shaw *et al.* 2005). It therefore provides an insight into the higher level relationships of some genera and also the age of these

	Chloroplast DNA						Nuclear DNA				
	rbcL	atpB	atpB -rbcL	matK	trnL-F (1)	rps4	ITS	ETS	26S nrDNA	18S	Reference
CONIFERS											
Athrotaxis	x			x							Gadek *et al.* 2000
Diselma	x			x							Gadek *et al.* 2000
Lagarostrobos	x										Conran *et al.* 2000
Microcachrys	x									x	Conran *et al.* 2000; Kelch 1998
ANGIOSPERMS											
Agastachys	x	x	x								Hoot & Douglas 1998; Weston & Barker 2006
Anodopetalum	x				x						Bradford & Barnes 2001
Asterotrichion							x				Tate *et al.* 2005
Bellendena	x	x	x				x				Hoot & Douglas 1998; Weston & Barker 2006
Campynema	x										Rudall *et al.* 2000
Cenarrhenes	x	x	x				x				Hoot & Douglas 1998; Weston & Barker 2006
Isophysis	x				x	x					Reeves *et al.* 2001
Milligania	x										Rudall *et al.* 2000
Odixia				x	x			x			Bayer *et al.* 2002
Planocarpa			x	x							Quinn *et al.* 2003
Prionotes	x										Crayn *et al.* 1998
Pterygopappus				x	x		x	x			Bayer *et al.* 2002; Breitweiser *et al.* 1999
Stonesiella					x		x				Crisp *et al.* 1999
Tetracarpaea	x	x		x					x	x	Fishbein *et al.* 2001
Winifredia	x				x						Briggs *et al.* 2000, Linder *et al.* 2003

(1) trnL-F includes trnL intron

lineages (Table 1). For lower level taxonomic studies non-coding chloroplast and DNA sequence data, including *trn*L-F, *trn*L intron, ETS and *atp*B-*rbc*L region, have been used to study the affinities of other genera (Table 1). It is recognised that while these distinctions could be viewed as two extremes within a continuum, they appear to be useful for describing the Tasmanian endemic genera.

Crisp *et al.* (2004) have also argued that the pattern of branching, and branch lengths can provide insights into the phylogenetic history of the group of genera being studied. They pointed out that this is possible when the branch lengths in phylogenies are proportional to evolutionary change (phylograms) or time (chronograms). A near simultaneous appearance of many new lineages is therefore indicative of a rapid and explosive radiation (Crisp *et al.* 2004), and it is suggested here that this pattern is consistent with that seen in some groups of genera in Tasmania. A steady rate of radiation is more likely to result in a more exponential pattern and longer branch lengths and this is seen in groups that have a longer evolutionary history (Crisp *et al.* 2004). Genera that are interpreted to be palaeoendemics are separated from other genera by long branch lengths, and they are often relatively early offshoots in their respective clades, and are therefore phylogenetically isolated.

When the data from both slowly (e.g. *rbc*L) and rapidly evolving DNA regions (e.g. *trn*L-F) are used in combination they may resolve different parts of the same tree (Briggs *et al.* 2000). In the case of *Winifredia*, *rbc*L data resolves nodes near the root of the tree and places it in a clade with *Taraxis* and *Empodisma* (Briggs *et al.* 2000). The clade is an early offshoot of the Restionaceae. The three genera share a one-base deletion in the *trn*L intron (Briggs *et al.* 2000). The *trn*L intron is used for understanding lower level relationships between genera and species.

In some studies the relative contribution of the different sets of sequence data to the topology of the tree are not explained fully e.g. *Odixia* and *Pterygopappus* (Bayer *et al.* 2002). It is therefore difficult to ascertain which sets of sequence data are determining tree structure. In the absence of sufficiently detailed phylogenetic studies, and/or a corroborated fossil record, the status of some genera, in terms of their endemicity, is unclear.

How many genera are restricted to Tasmania?

As pointed out by Orthia *et al.* (2005), the classification of plants and animals is undertaken to: (a) allow reference to a taxon, and the information known on the taxon, (b) provide boundaries that can be recognised for that taxon at a point in time, and (c) enable us to determine the 'relatedness' of this taxon to other organisms.

The aim in undertaking taxonomic research is to clarify the systematic relationships between the group of plants being studied and provide a classification that represents their evolutionary history. The underlying principle that determines 'relatedness' is monophyly, i.e. genera in a family are more closely related to each

◄ **Table 1.** Comparison of the various chloroplast and nuclear DNA genes that have been used to study the phylogenetic relationships of Tasmania's endemic genera.

other than they are to a genus in another family, and monophyly is the primary criterion for delimiting taxa (de Queroiz and Donoghue 1988, 1990). The identification of monophyletic relationships, as pointed out by many authors, is therefore the search to identify the 'true' relationships between taxa.

Hooker (1857) in the *Flora Tasmaniae* records 22 genera that he described as being 'absolutely peculiar to Tasmania'. Burbidge (1960) indicated that 28 genera are endemic to Tasmania. Hill and Orchard (1999) record 18 genera, with no endemic families in Tasmania. This review concludes that there are currently 19 genera in Tasmania that are considered endemics, although the status of some taxa, and whether they warrant recognition at the generic level, remains equivocal. As Orthia *et al.* (2005) point out, categories such as 'species' and 'genera' are human constructions and these concepts may change as additional information is obtained.

To cite two Tasmanian examples, in 1998, Briggs and Johnson, based upon a morphological study, erected a new endemic genus, *Acion,* in the family Restionaceae to accommodate two endemic species that occur in the state. More detailed research by Briggs and Johnson (2004), incorporating molecular studies using *rbc*L, *trn*F-*trn*L and *mat*K sequence data (Briggs *et al.* 2000), resulted in the reinterpretation of some critical morphological characters. The two species were shown to be embedded in a clade with species of *Chordifex* from Western Australia, so the generic status of *Acion* could no longer be supported.

Relatively recent molecular studies by Quinn *et al.* (2003) on the Styphelieae would indicate that *Cyathodes* as currently defined is not monophyletic. *Cyathodes sensu stricto,* as defined by Quinn *et al.* (2003) only includes Tasmanian species and therefore would represent another endemic genus for the state. Our understanding of the relationships of some genera in Tasmania is still quite limited and it is likely, therefore, that the number of endemic genera will change as our understanding of the phylogenetic relationships of the Flora improves.

Use of molecular phylogenies to understand biogeographical relationships

Morphology-based phylogenetic studies have provided a framework to understand the relationships within flowering plants and conifers. Molecular systematics has provided support for the existing phylogenetic relationships for some taxa, e.g. *Isophysis.* The placement of some other Tasmanian taxa has been unclear, and molecular systematics is providing new insights into the relationships of these genera. This has been the case with *Tetracarpaea* that was first tentatively placed within the Cunoniaceae (Hooker 1857), then later referred to the Grossulariaceae (Cronquist 1981), Escalloniaceae (Curtis and Morris 1993) and in its own family Tetracarpaeaceae (Takhtajan 1997). Molecular data indicate that it is most closely related to the Haloragaceae *sensu stricto* and *Penthorum* (Fishbein *et al.* 2001). Reconstructing the phylogeny of each of these genera provides the opportunity to also see if generalised patterns exist in the biogeographical relationships of the different genera.

If the sampling of taxa for phylogenetic studies is incomplete, and/or choice of characters or sequence data is inappropriate then misleading phylogenetic and biogeographical results will occur. Brunsfield *et al.* (1994) studied a selection of genera in the Cupressaceae and Taxodiaceae using *rbc*L sequence data. In this study the Tasmanian endemic, *Diselma* was sister to *Widdringtonia* from southern Africa. A latter study of *mat*K sequences by Gadek *et al.* (2000), that sampled all genera in the Cupressaceae, showed that while *Diselma* was closely related to *Widdringtonia*, it was more closely related to *Fitzroya* from South America.

In some studies, DNA sequence data have been compiled from only a selection of species from within the family being studied. In some tribes, such as the Gnaphalieae (Asteraceae) or Styphelieae (Ericaceae), the analysis of sequence data is providing insights into overall relationships within these tribes (e.g. Bayer *et al.* 2002; Quinn *et al.* 2005). The sampling of species and genera in both the Gnaphalieae and Styphelieae is still too incomplete to fully understand generic concepts within these tribes to confidently determine sister group relationships.

CONIFERS

Cupressaceae

Athrotaxis D.Don

Two species – *A. selaginoides* D.Don, *A. cupressoides* D.Don and *A.* x *laxifolia* Hook. (Fig. 2A).

Phylogenetic and Biogeographical Relationships: In an analysis of *rbc*L and *mat*K sequence data, *Athrotaxis* was shown to be a basal member in the Cupressaceae, and was placed in its own subfamily, Athrotaxidoideae, by Gadek *et al.* (2000). The subfamily was defined as trees with adult leaves that are monomorphic and helically arranged, cones that are solitary and terminal, with three to six (inverted) ovules per cone scale, two cotyledons in seedlings, and amphistomatic leaves (Gadek *et al.* 2000).

The family Cupressaceae *sensu lato* includes Northern and Southern Hemisphere genera, and the Athrotaxidoideae are sister to a very large clade comprising three subfamilies from the Northern Hemisphere (Cupressoideae, Sequoioideae and Taxodioideae) and one from the Southern Hemisphere (Callitroideae) in the analyses of Gadek *et al.* (2000).

Fossil Record: There is no substantiated fossil record outside of Tasmania, and early records, such as Florin (1963) from New Zealand and South America, and Bose (1955) from Queensland need checking. Early Oligocene and Early Miocene fossils from Tasmania have been described as an extinct species of *Athrotaxis* (Hill *et al.* 1993a). Pleistocene fossils of extant *Athrotaxis* species are also known from several sites in western Tasmania (Jordan 1995).

The fossil *Athrotaxis* leaves at the Regatta Point site are morphologically diverse and conform to the variation seen in hybrid swarms found at Mts Read and Kate in western Tasmania (G. Jordan pers. comm. 2006). Oil chemistry data (Brophy *et al.* 2001), RAPDs (Isoda *et al.* 2000) and nucleotide sequence data from four chloroplast genes, *mat*K, *chl*K, intergenic spacer (IGS) region between *trn*L and *trn*F (Kusumi *et al.* 2000) support a hybrid origin for *A.* x *laxifolia*.

The genus is an early offshoot of the family (Gadek *et al.* 2000) that has been present in Tasmania since the Early


A
B
C
D

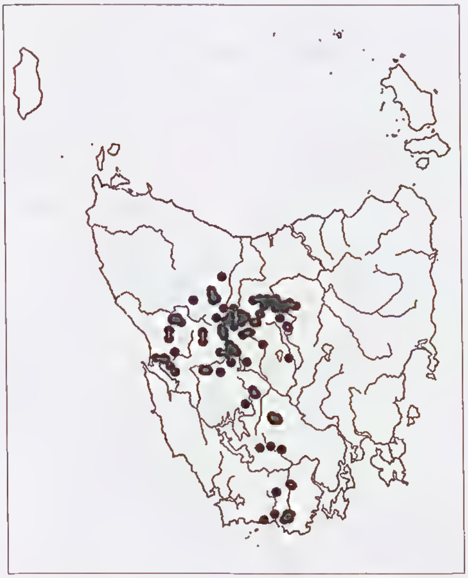


Fig. 3. Distribution of *Athrotaxis.*

Oligocene. It is sister to a large group of genera including the sequoioid clade (*Metasequoia, Sequoia* and *Sequoiadendron*). Upper Cretaceous-aged fossils have been referred to the sequoioid clade in both Canada (Chandrasekharam 1974) and Australia (Peters and Christophel 1978). The fossil record therefore indicates that some diversification of the sequoioid clade had occurred by the Upper Cretaceous, and it implies that the subfamily Athrotaxidoideae had also evolved by this time.

Habit and Ecology: Both species of *Athrotaxis* are trees. *Athrotaxis cupressoides* grows in open montane habitats from 760 to 1350 m a.s.l., while *A. selaginoides* occurs on the valley floor and in fire-protected slopes in thamnic and implicate rainforest from sea level, but usually between 400 and 1300 m a.s.l. (Gibson *et al.* 1995).

Distribution: Both species, and the hybrid, occur in the Central Highlands and montane areas in the far south of the state (Fig. 3).

Remarks: *Athrotaxis* is considered a palaeoendemic based upon molecular data and evidence from the fossil record. The Athrotaxidoideae is the culmination of a very ancient lineage, especially relative to Angiosperm genera, that had diverged prior to the separation of the other subfamilies (Callitroideae, Cupressoideae, Sequoioideae and Taxodioideae) from each other. As *Athrotaxis* is sister to groups of genera from both the Northern and Southern Hemisphere, a more detailed discussion of biogeographical relationships is not possible.

Diselma Hook.f.

Monotypic genus – *Diselma archeri* Hook.f. (Fig. 2B).

Phylogenetic and Biogeographical Relationships: *Diselma* is separated from other genera in the Cupressaceae *sensu lato* in having female cones that are less than 5 mm in diameter and which consist of two pairs of fertile scales; and closely imbricate, decussate leaves (Hill 1998). *Diselma* shares with *Fitzroya* heavy lignification of wood ray parenchyma and numerous small intraray pits that appear as prominent nodules on the tangential walls of the ray

◄ **Fig. 2.** Photographs of selected Tasmanian endemic conifer genera.

A. *Athrotaxis selaginoides.* **B.** *Diselma archeri.* **C.** *Lagarostrobos franklinii,* showing the typical weeping habit of the tree. **D.** *Microcachrys tetragona,* showing the characteristic red, slightly fleshy, female cones.

PHOTOGRAPHS SUPPLIED BY HANS AND ANNIE WAPSTRA.

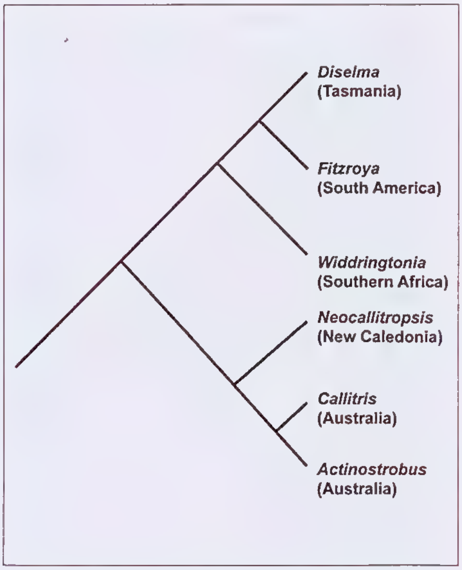


Fig. 4. Simplified tree derived from analysis of *mat*K and non-molecular data from Gadek *et al.* (2000) which shows the phylogenetic relationships of *Diselma* to closely related genera in the Cupressaceae.

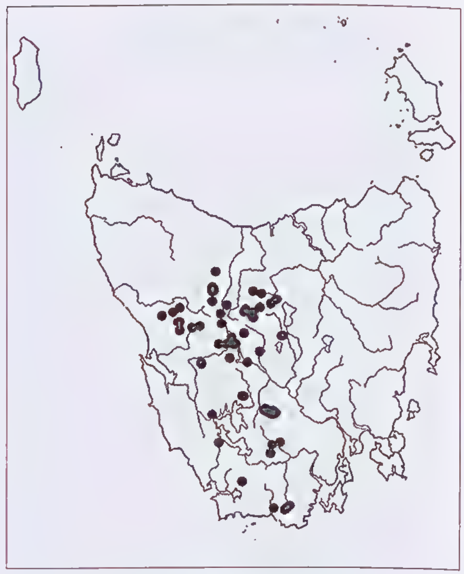


Fig. 5. Distribution of *Diselma*.

parenchyma (Gadek *et al.* 2000). Analysis of *rbc*L and *mat*K sequence data placed *Diselma* in the subfamily Callitroideae, a Southern Hemisphere clade in the Cupressaceae. The Callitroideae include *Actinostrobus, Callitris, Diselma, Fitzroya, Libocedrus, Neocallitropsis, Papuacedrus, Pilgerodendron, Papuacedrus* and *Widdringtonia* (Gadek *et al.* 2000).

Diselma is sister to the South American genus *Fitzroya*, and this clade is sister to *Widdringtonia* from southern Africa (Fig. 4). This clade is sister to a New Caledonian (*Neocallitropsis*) – Australian clade (*Actinostrobus/Callitris*) (Fig. 4).

Fossil Record: *Fitroya* is known from Oligocene fossils in Tasmania (Hill and Whang 1996) and it is therefore logical to assume that its sister genus, *Diselma*, had also evolved by this time. Pleistocene-aged fossils of *Diselma* have been recorded from sediments at Regatta Point in western Tasmania (Jordan *et al.* 1995).

Habit and Ecology: *Diselma* is a prostrate shrub or small tree (rarely up to 18 m high, G. Jordan pers. comm. 2006) in alpine heathland and shrubland, and in montane implicate rainforest and forest from 570 m a.s.l., but usually between 800 and 1400 m a.s.l.

Distribution: Mainly central Tasmania and the far south of the state (Fig. 5).

Remarks: *Diselma* is considered a palaeo-endemic. Estimates of age based upon vicariance between South America and Tasmania would suggest a minimum early Tertiary age for *Diselma*, and a minimum 25 My B.P. can be inferred from the fossil record.

Podocarpaceae
Lagarostrobos C.J.Quinn

Monotypic genus – *L. franklinii* (Hook.f.) C.J.Quinn (Fig. 2C).

Phylogenetic and Biogeographical Relationships: Quinn (1982), in his analysis of relationships in the Podocarpaceae, recognised two species in *Lagarostrobos*: *L. franklinii* from Tasmania and *L. colensoi* (Hook.) C.J.Quinn from New Zealand. He defined the genus on characters including the lax open structure of the cone, presence of phloem fibres, one (rarely two) cross-field pits in secondary xylem and resin ducts in the leaves.

Molloy (1995) erected a segregate genus *Manoao* for *L. colensoi* and pointed out that the vegetative and wood anatomy characters recognised by Quinn (1982) occurred in other genera in the Podocarpaceae. Molloy (1995) identified 36 morphological and chemical differences between these two genera but did not analyse this variation phylogenetically. The two genera differ in karyotype, pollen morphology, the number of fertile bracts in the female cone, the appearance of the epimatium and seed morphology.

In a recent paper on the oil chemistry of selected genera in the Podocarpaceae no qualitative differences in oil chemistry were detected between *L. franklinii* and *M. colensoi* (Hook.) Molloy, when compared with other genera in the family (Brophy *et al.* 2002). Differences in oil chemistry therefore provide no support for recognising two separate genera.

Based upon the analysis of chloroplast *rbc*L sequence data, *Lagarostrobos* is sister to the New Zealand genus *Manoao* (Conran *et al.* 2000). Conran *et al.* (2000) commented that each branch length consisted of more than 30 nucleotide changes, which indicated a long history of separation between these genera. Conran *et al.* (2000) argued that the demonstrated monophyly, tempered by an underlying aim of taxonomic equivalence between genera in the Podocarpaceae, would support the retention of both species in *Lagarostrobos*. While *Lagarostrobos* and *Manoao* would have similar rank, it is an arbitrary decision in a phylogenetic sense, as to whether they are classified as sister species and/or genera.

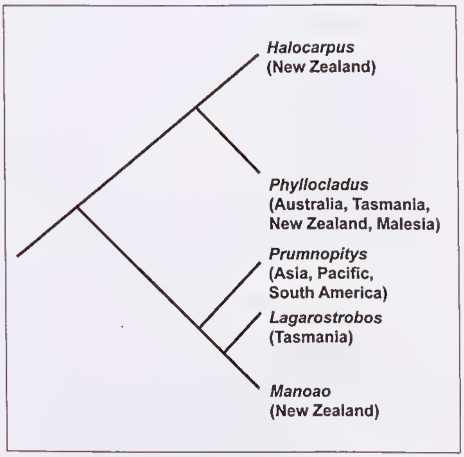


Fig. 6. Simplified tree derived from analysis of *rbc*L sequences by Conran *et al.* (2000) which shows the phylogenetic relationships of *Lagarostrobos* to closely related genera in the Podocarpaceae.

Lagarostrobos and *Manoao* are sister to *Prumnopitys* (including *Sundacarpus*), and this clade is sister to the *Phyllocladus*/*Halocarpus* clade (Conran *et al.* 2000) (Fig. 6). All genera are Southern Hemisphere taxa, and *Prumnopitys*, and the *Phyllocladus*/*Halocarpus* clade occur in Australia, Malesia, New Caledonia, New Zealand and South America (Enright *et al.* 1995) (Fig. 6).

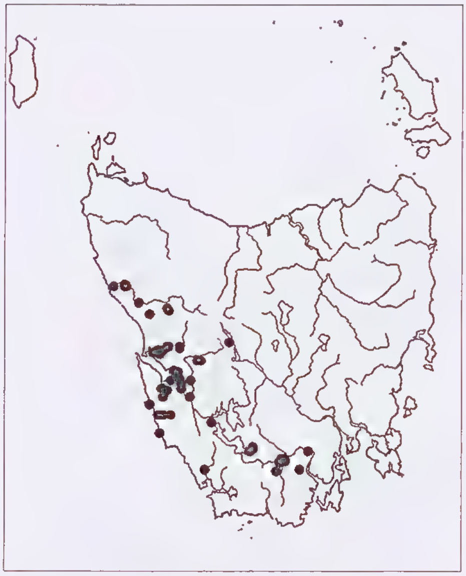


Fig. 7. Distribution of *Lagarostrobos.*

Fossil Record: Macrofossil remains of *Lagarostrobos* are known from the Early Pleistocene floras of western Tasmania (Jordan 1995). The fossil pollen *Phyllocladidites mawsonii* Cookson ex Couper, has been compared with that of extant *Lagarostrobos* and is known from the Late Cretaceous of mainland Australia and New Zealand (Macphail *et al.* 1993). The fossil record therefore indicates that *Lagarostrobos* or plants producing *Lagarostrobos*-like pollen were more widespread in the past. A sole surviving species, *L. franklinii,* is restricted to Tasmania.

Habit and Ecology: *Lagarostrobos* is a tree or rarely a shrub, e.g. at Mt Read (G. Jordan pers. comm. 2006). It occurs in thamnic and implicate rainforest, as a riparian tree in gallery rainforest along rivers in western Tasmania (Gibson *et al.* 1995) and rarely in alpine conifer heath (G. Jordan pers. comm. 2006). It ranges from sea level to 750 m, with a few stands up to 1030 m (Gibson *et al.* 1995).

Distribution: Largely western Tasmania (Fig. 7).

Remarks: Both *Lagarostrobos* and its sister taxon *Manoao* are considered palaeo-endemics. Fossil pollen has been referred to *Lagarostrobos* (including *Manoao* in the past) which indicates a Cretaceous origin for this lineage. If vicariance is invoked a Cretaceous age would also be inferred based upon the divergence of New Zealand from Australia.

Microcachrys Hook.f.

Monotypic genus – *M. tetragona* (Hook.) Hook.f. (Fig. 2D).

Phylogenetic and Biogeographical Relationships: *Microcachrys* was separated from other genera in the Podocarpaceae based upon the ovules being inverted and partially covered by an epimatium, and the bracts on the female cones becoming succulent and scarlet at maturity (Quinn 1982). The adult leaves are scale-like, decussate with a rounded dorsal keel (Quinn 1982).

Kelch's (1997) analysis of relationships, based solely upon morphology, placed *Microcachrys* as sister to *Pherosphaera* (previously *Microstrobos* see Brummitt *et al.* 2004). Kelch pointed out that both genera have trisaccate pollen which does not occur elsewhere in the family, and his morphological analysis indicated that they were sister taxa. Kelch (1997) also suggested that *Microcachrys* and *Pherosphaera* were related to the other scale-leaved genera including *Lagarostrobos* and *Manoao.*

In a limited study of 18S ribosomal DNA, Kelch (1998) recognised that while a sister relationship between *Microcachrys* and *Pherosphaera* was maintained, the results from this study were largely not congruent with the morphology-based phylogeny. The 18S study therefore did not support the grouping of taxa into a clade of scale-leaved genera.

Conran *et al.*'s (2000) analysis, based upon *rbc*L sequence data, placed *Microcachrys* in a trichotomy with *Pherosphaera* (which has two relictual species, one restricted to the Blue Mountains of eastern Australia, and a second species in Tasmania) and a clade consisting of *Acmopyle*, podocarpoid (*Podocarpus, Retrophyllum, Afrocarpus*) and dacrydioid (*Dacrycarpus, Dacrydium, Falcatifolium*) genera that have a widespread Southern Hemisphere distribution (Fig. 8).

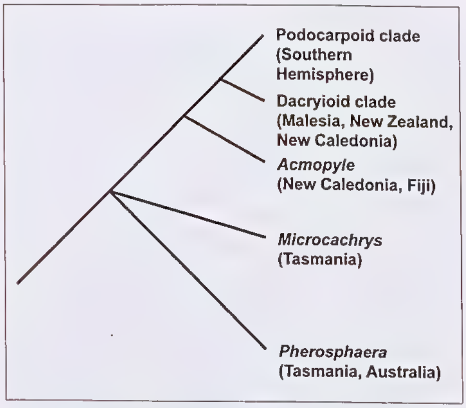


Fig. 8. Simplified tree derived from analysis of *rbc*L sequences by Conran *et al.* (2000) which shows the phylogenetic relationships of *Microcachrys* to closely related genera in the Podocarpaceae.

Fossil Record: *Microcachrydites antarcticus* Cookson pollen ranges from the Jurassic through to the Miocene (Hill 1994). It has been compared to both *Microcachrys* and *Pherosphaera* pollen (Dettmann 1994), although most palynologists consider it to have closer affinities with *Microcachrys* (Hill 1994; Macphail *et al.* 1994; Martin 1994). Another fossil pollen taxon, *Podosporites parvus* (Couper) Mildenhall, which is first recorded from the Oligocene of New Zealand and Australia, has also been suggested as having affinities with *Microcachrys* (Macphail *et al.* 1994).

Fossil wood from the Lower Cretaceous of Victoria has been assigned to *Microcachrys* (Ingle 1975), but the brief description and the lack of comparison with other Podocarpaceae make the record dubious. Leaf remains from the Miocene-aged Latrobe Valley (Victoria) (Blackburn 1985) and the lowland Pleistocene Regatta Point locality in Tasmania (Jordan 1995) have also been attributed to *Microcachrys*. As Hill (1995) pointed out, these records, if confirmed, and assuming they are derived from locally occurring plants, indicate that the plants were growing in significantly different vegetation communities from those of modern *M. tetragona*.

Habit and Ecology: *Microcachrys* is a decumbent shrub in alpine heath and shrub communities, from 850 m a.s.l., but usually occurs between 1000 and 1450 m a.s.l.

Distribution: Montane areas in Central Highlands and the far south of the state. (Fig. 9).

Remarks: Based upon Conran *et al.*'s (2000) analysis, further resolution of the biogeographical relationships of *Microcachrys* is not possible. The long branch lengths between genera suggest no close affinities with other genera in the

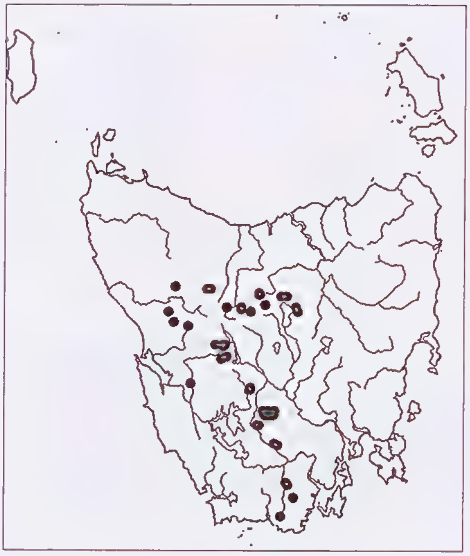


Fig. 9. Distribution of *Microcachrys.*

Podocarpaceae, and *Microcachrys* is therefore extremely isolated, and is considered a palaeoendemic.

The shared pollen character of trisaccate pollen, however, would suggest a sister relationship to the mainland Australian/Tasmanian genus *Pherosphaera*. The isolated phylogenetic position of *Microcachrys/Pherosphaera* (Conran *et al.* 2000), and the fossil record of outwardly similar trisaccate pollen to that produced by these extant genera (Dettmann 1994), supports Hill's (1995) suggestion that these extant taxa are the last remnants of once more diverse and widely distributed lineages.

Microcachrys is either the sole surviving member of a lineage with *Microcachrydites antarcticus* type pollen, or alternatively, the extant genus was more widespread in southern Australia in the past. It would be misleading to attribute all of these fossil pollen records to an extant genus and/or species.

DICOTYLEDONS

Asteraceae

Odixia Orch.

Two species – *O. angusta* (Wakef.) Orch. and *O. achlaena* (D.I.Morris) Orch. (Fig. 10A).

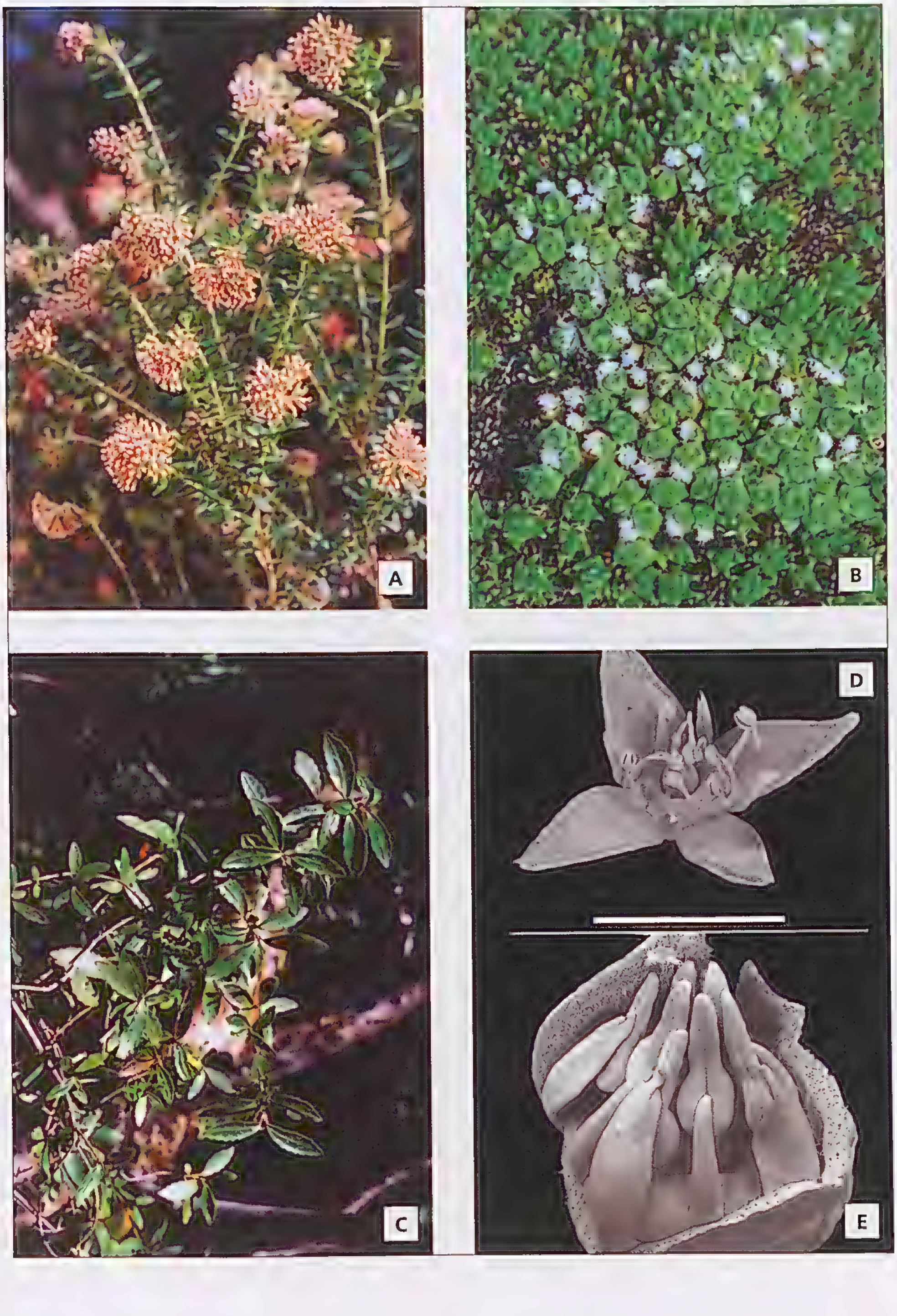
Phylogenetic and Biogeographical Relationships: Orchard (1981) erected *Odixia* for two species that had been previously referred to either *Ixodia* or *Helichrysum*. *Odixia* was separated from *Ixodia* by Orchard (2005, p. 1) in having five to six florets per capitulum, the innermost membranous phyllaries are +/- linear and have a narrow white tip and other characters. *Ixodia*, in contrast, has green and subfleshy phyllaries, and a capitula of 20 to 30 florets (Orchard 2005).

Odixia is one of a group of segregate genera in the *Cassinia* group that lacks a pappus. Based upon a cladistic analysis of morphological characters, Anderberg (1991, p. 87) concluded that the technical characters used to delimit genera in the

▶ **Fig. 10.** Photographs of the habit of selected Tasmanian endemic genera in the Asteraceae and Cunoniaceae.

A. *Odixia angusta,* in flower. **B.** *Pterygopappus lawrencei,* in flower; note typical cushion plant habit of the plant. **C–E.** *Anodopetalum biglandulosum.* **C.** Detail of leaves. **D.** Micrograph of flower showing the distally notched petals. **E.** Dissected flower in bud; note the long sterile appendage on each anther.

Photographs A–C supplied by Hans and Annie Wapstra, D–E by author.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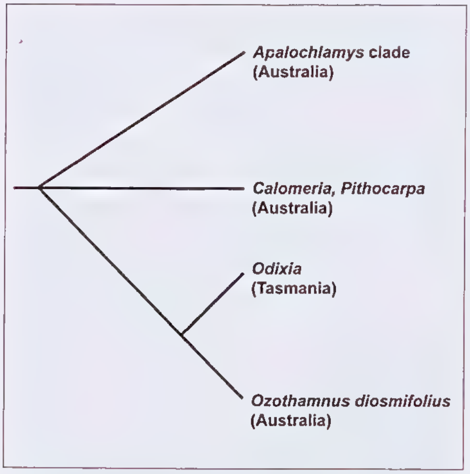

Fig. 11. Simplified tree derived from analysis of chloroplast and nuclear sequence data (*trn*L intron, *trn*L-*trn*F intergenic spacer, *mat*K and ETS) by Bayer *et al.* (2002) which shows the phylogenetic relationships of *Odixia* to closely related genera in the Asteraceae.

Fig. 12. Distribution of *Odixia*.

Cassinia group do not reflect their 'true' phylogenetic relationships, and therefore it seems likely that the generic concepts within this group of species require revision. Anderberg's (1991) analysis placed *Odixia* sister to *Ixodia*.

Bayer *et al.* (2002) undertook a phylogenetic analysis, using chloroplast and nuclear sequence data (*trn*L intron, *trn*L-*trn*F intergenic spacer, *mat*K and *ETS*), from a wide cross section of species and genera in the tribe Gnaphalieae. In this analysis, *Odixia angusta* is sister to *Ozothamnus diosmifolius* (Vent.) A.Cunn. ex DC. This clade forms a trichotomy with the *Calomeria*/*Pithocarpa* clade and the *Apalochlamys* clade, the latter consisting of *Eriochlamys*, *Apalochlamys*, *Argyroglottis* and *Ammobium* (Fig. 11). *Ixodia* forms a clade with *Argentipallium* and *Bellida* and has more distant links with the above three clades. *Ozothamnus* was shown to be polyphyletic: the other *Ozothamnus* species are placed in a clade with *Cassinia* and *Haeckeria* (Bayer *et al.* 2002, but see comments by Orchard 2005, p. 3).

Bayer *et al.* (2002) argued that the Gnaphalieae have undergone an explosive radiation, and *Odixia* could therefore be interpreted as a recent segregate within this group. Bayer *et al.*'s (2002) broad-based analysis provided an overview of phylogenetic relationships within the Gnaphalieae, but more extensive sampling of taxa will result in a more accurate understanding of relationships within the Gnaphalieae.

Fossil Record: None.

Habit and Ecology: Both species of *Odixia* are shrubs that grow to two or three metres, and occur as undershrubs in *Eucalyptus* forest woodland; *O. angusta* also occurs in swampy areas subject to inundation. Both species occur from sea level to 350 m a.s.l.

Distribution: Eastern lowland Tasmania (Fig. 12).

Remarks: *Odixia* is interpreted as a neo-endemic. The sampling of taxa within the Gnaphalieae by Bayer *et al.* (2002) does not include enough taxa to fully understand generic limits. Until the generic limits within the Gnaphalieae are resolved, and a phylogenetic understanding of the character evolution within the tribe is achieved, the recognition of some genera within this tribe will be largely problematic.

Pterygopappus Hook.f.

Monotypic genus – *P. lawrencii* Hook.f. (Fig. 10B).

Phylogenetic and Biogeographical Relationships: *Pterygopappus* was distinguished from other genera in the Asteraceae by characters including a pappus of 6 or fewer plumose capillary bristles that occur in one row and have subclavate apical cells (Anderberg 1991). The compact habit and densely appressed leaves are consistent with the cushion-forming habit of the plant (Anderberg 1991).

Anderberg's (1991) morphological analysis placed *Pterygopappus* in subtribe Loricariinae. Molecular studies, using ITS sequence data, placed *Pterygopappus* in a clade with the two Tasmanian species of *Ewartia* (Breitwieser *et al.* 1999), which was thought to have affinities with the subtribe Casiniinae (Anderberg 1991). Analyses of chloroplast and nuclear sequence data by Bayer *et al.* (2002) also have it closely related to *Ewartia*. Bayer *et al.*'s (2002) study placed *Pterygopappus* as sister to a group of genera including *Stuartina*, *Ewartia*, some *Ozothamnus* spp. and *Acanthocladium* (Fig. 13). These genera

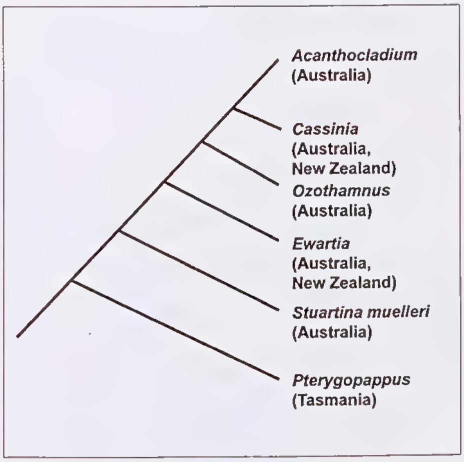

Fig. 13. Simplified tree derived from analysis of chloroplast and nuclear sequence data (*trn*L intron, *trn*L-*trn*F intergenic spacer, *mat*K and ETS) by Bayer *et al.* (2002) which shows the phylogenetic relationships of *Pterygopappus* to closely related genera in the Asteraceae.

were all placed in subtribe Casiniinae, with the exception of *Stuartina*, which was thought to have affinities with the subtribe Gnaphaliinae (Anderberg 1991). All the genera are perennial herbs and/or cushion plants (Bayer *et al.* 2002).

Fossil Record: None.

Habit and Ecology: *Pterygopappus* is a herb that grows in alpine herb fields, moorland and cushion field and heathland communities from 950 to 1615 m a.s.l. It is the only alpine endemic genus in Tasmania that is largely confined to areas above the tree line.

Distribution: Montane peaks in Central Tasmania, Ben Lomond and the far south of the state (Fig. 14).

Remarks: A more comprehensive phylogenetic analysis is required to determine the sister taxa and therefore biogeographical

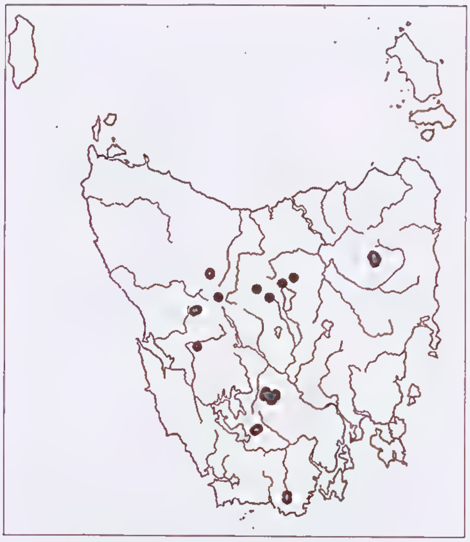

Fig. 14. Distribution of *Pterygopappus.*

relationships of *Pterygopappus*. The current molecular data (Bayer *et al.* 2002), which largely samples Australian taxa, would suggest it is sister to a group of largely southern Australian taxa (Fig. 13). Its status as an endemic is unclear.

Cunoniaceae
Anodopetalum A.Cunn ex Endl.

Monotypic genus – *A. biglandulosum* A.Cunn. ex Hook.f. (Fig. 10C–E).

Phylogenetic and Biogeographical Relationships: *Anodopetalum* is placed in the tribe Schizomerieae based upon morphological characters such as having incised petals, an annular floral nectary and heterogenous pollen tectum, and on molecular characters based upon chloroplast DNA sequence data (Bradford and Barnes 2001). Morphological characters that have been used to separate *Anodopetalum* from the other genera in the Schizomerieae are the strongly dehiscent fruits and winged seeds (Barnes and Rozefelds 2000; Rozefelds and Barnes 2002).

The relationships between genera in the clade, based upon morphology and chloroplast DNA (*rbc*L gene and *trn*L-*trn*F region), show that *Anodopetalum* is sister to the South African genus (*Platylophus*). This clade is sister to the Australian/New Guinean genus *Ceratopetalum*, and they collectively form a clade sister to the Australian/Malesian genus *Schizomeria* (Bradford and Barnes 2001; Bradford *et al.* 2004) (Fig. 15).

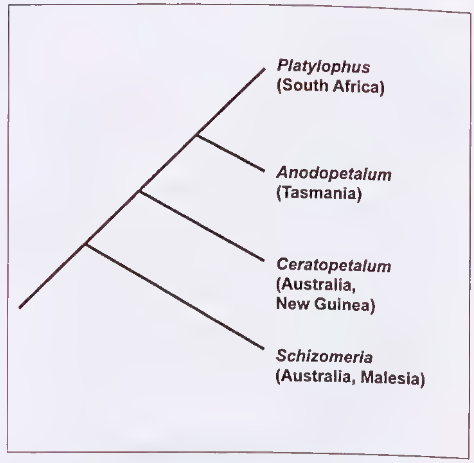

Fig. 15. Simplified tree derived from analysis of *rbc*L gene and *trn*L-*trn*F region, and morphological characters by Bradford and Barnes (2001) which shows the position of *Anodopetalum* within the Schizomerieae (Cunoniaceae).

Fossil Record: The oldest fossils of *Anodopetalum* are from the Early Pleistocene Regatta Point locality in Tasmania (Barnes *et al.* 2001). The comment by Balmer *et al.* (2004, p. 11) that *Anodopetalum* evolved in the Pleistocene is

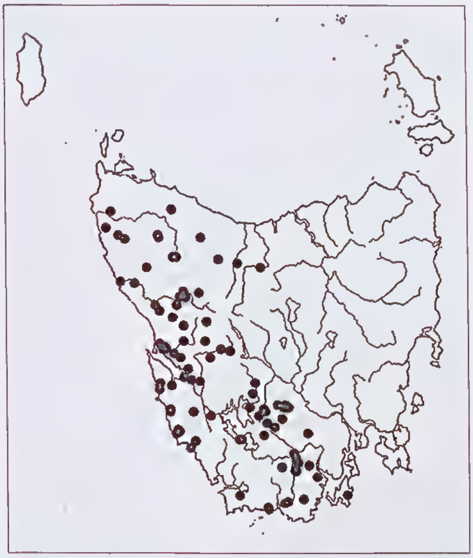

Fig. 16. Distribution of *Anodopetalum.*

based upon a misinterpretation of Barnes *et al.*'s (2001) paper.

Habit and Ecology: *Anodopetalum* is small tree occurring in thamnic and implicate rainforest communities, from near sea level on the west coast of Tasmania to 1100 metres at Mt Read (G. Jordan pers. comm. 2006).

Distribution: Western and southern Tasmania (Fig. 16).

Remarks: *Anodopetalum* is interpreted as a palaeoendemic. Eocene-aged fossils have been attributed to *Ceratopetalum* (Rozefelds and Barnes 2002), and it therefore could be argued that its sister taxa, *Anodopetalum* in Tasmania and *Platylophus* in South Africa had also evolved by this time. Estimates of age based upon vicariance would suggest a significantly older Cretaceous origin for these genera.

Ericaceae: Styphelioideae

(Classification of Ericaceae see Stevens (2006))

Planocarpa Weiller

Three species – *P. nitida* (Jarman) Weiller, *P. petiolaris* (DC.) Weiller and *P. sulcata* (Mihacaich) Weiller (Fig. 17A).

Phylogenetic and Biogeographical Relationships: *Planocarpa* differs from *Cyathodes* in that the inflorescence is axillary, consisting of one to three flowers in a reduced spike and a terminal rudimentary bud; each flower is subtended by one bract and two bracteoles, and the drupe is a depressed sphere (Weiller 1996b, p. 509). In *Cyathodes* the inflorescence is terminal and lacks a terminal rudimentary bud, each flower has numerous bracts and bracteoles below the flower, and the fruit is spherical (Weiller 1996a; Quinn *et al.* 2005).

Recent analyses of *mat*K gene and *atp*B-*rbc*L sequences (Quinn *et al.* 2003), and combined morphological and molecular (*atp*B-*rbc*L) studies (Quinn *et al.* 2005), supported the monophyly of *Planocarpa*. *Planocarpa* represents a relatively early lineage within the tribe Styphelieae that shows no close relationship with any other genus (Chris Quinn pers. comm. 2007).

Fossil Record: None.

Habit and Ecology: *Planocarpa* are shrubs that grow to one metre high, and occur in alpine heath and shrub communities, above 950 m a.s.l.

Distribution: *Planocarpa nitida* is restricted to dolerite regions of the Central Plateau, while *P. petiolaris* occurs on dolerite regions of central and south-eastern


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D

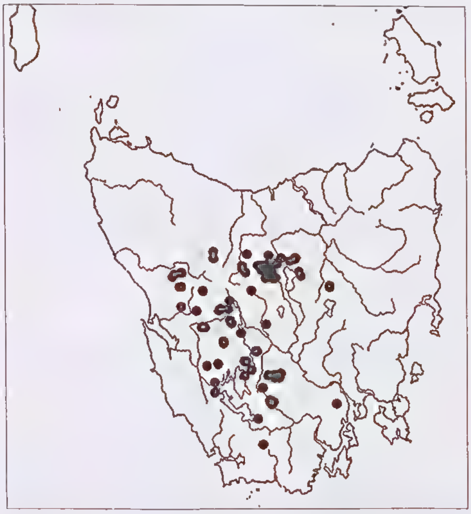


Fig. 18. Distribution of *Planocarpa*.

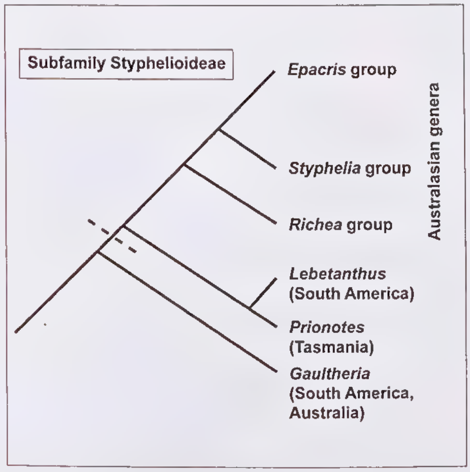


Fig. 19. Simplified tree derived from analysis of *rbc*L sequences by Crayn *et al.* (1998) which shows the phylogenetic relationships of *Prionotes* within the subfamily Styphelioideae. *Prionotes* is sister to *Lebetanthus*. With the exception of *Lebetanthus*, which occurs in South America, the subfamily are restricted to the Australasian region.

plateaus, and *P. sulcata* is restricted to the western mountains (Fig. 18).

Remarks: *Planocarpa* is considered a palaeo-endemic and its biogeographical links are thought to lie with Australian taxa.

Prionotes R.Br.

Monotypic genus – *P. cerinthoides* (Labill.) R.Br. (Fig. 17B).

Phylogenetic and Biogeographical Relationships: *Prionotes* has been shown to be morphologically isolated within the subfamily Styphelioideae and has minutely dentate leaves and a climbing habit. These characters do not occur in other genera in the subfamily (Powell *et al.* 1996). *Prionotes* has been considered closely related to the South American genus *Lebetanthus* (Arroyo 1975), and cladistic analyses using morphological data (Powell *et al.* 1996) suggested that both genera occupy an intermediate position between the Styphelioideae, and some genera in the Ericaceae.

In Crayn *et al.*'s (1996) analysis of *rbc*L sequence data, *Prionotes* is sister to the rest of the subfamily, and not closely related to *Lebetanthus*. *Lebetanthus* was shown to be related to other Southern Hemisphere Ericaceae, e.g. *Gaultheria* and *Leucothoë* (Vaccinioideae) (Crayn *et al.*

◄ **Fig. 17.** Photographs of the habit of selected Tasmanian endemic genera in the Ericaceae and Fabaceae.

A. *Planocarpa petiolaris*; note the typical fleshy, compressed fruits. **B.** *Prionotes cerinthoides* in flower; note the typical creeping habit. **C.** *Stonesiella selaginoides* in flower. **D.** *Tetracarpaea tasmanica* in flower.
PHOTOGRAPHS SUPPLIED BY HANS AND ANNIE WAPSTRA.

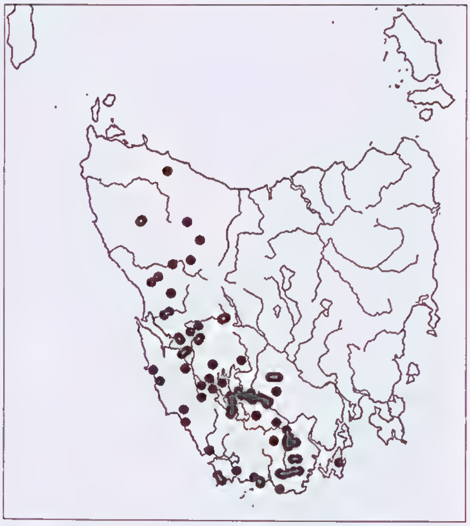


Fig. 20. Distribution of *Prionotes*.

1996). The authors revisited their work (Crayn *et al.* 1998) and discovered that the original sample of *Lebetanthus* used in the analysis was misidentified. The new study, again using *rbc*L, did reveal that *Prionotes* was sister to the South American genus *Lebetanthus* (Fig. 19). Together they form a clade sister to the rest of the subfamily (Fig. 19). The subfamily Styphelioideae occurs in Australia, New Zealand, some Pacific Islands, south east Asia, with a single genus in South America (*Lebetanthus*). This subfamily form a Southern Hemisphere clade in the Ericaceae (Crayn *et al.* 1996).

Fossil Record: None.

Habit and Ecology: *Prionotes* is a scrambling shrub, which occurs in rainforest and *Eucalyptus* woodland, and occasionally in subalpine shrubbery and exposed heathland, from near sea level on the west coast to 1130 m a.s.l.

Distribution: Western Tasmania and the far south of the state (Fig. 20).

Remarks: *Prionotes* is considered a palaeoendemic, and a minimum Eocene age for the *Prionotes/Lebetanthus* clade is inferred based upon estimates of age of the separation of the Australian plate from Antarctica and South America.

Fabaceae
Stonesiella Crisp and P.H.Weston

Monotypic genus – *S. selaginoides* (Hook.f) Crisp and P.H.Weston (Fig. 17C).

Phylogenetic and Biogeographical Relationships: Crisp *et al.* (1999a) erected a new genus for a single species from eastern Tasmania. *Stonesiella* was separated from related taxa in *Pultenaea* and *Almaleea*, by its minute stipules, that are neither scarious nor fused, and the possession of caducous bracts and auxotelic inflorescences.

In a combined analysis based upon morphology and molecular data (*trn*L-F) *Stonesiella* is sister to the Australian genus *Almaleea* (Crisp and Weston 1991), which also occurs in Tasmania. *Almaleea* and *Stonesiella* are sister to *Eutaxia* and *Pultenaea neurocalyx* Turcz., which are also Australian taxa (Fig. 21) (Crisp *et al.* 1999a). *Stonesiella* is part of a southern Australian/Tasmanian clade. Molecular studies using ITS and *trn*L-F data sets were incongruent (Crisp *et al.* 1999a), so its 'true' phylogenetic position is uncertain. The tribe Mirbelieae are a largely Australian group, and Orthia *et al.* (2005) have argued that the tribe have undergone an explosive and recent radiation.

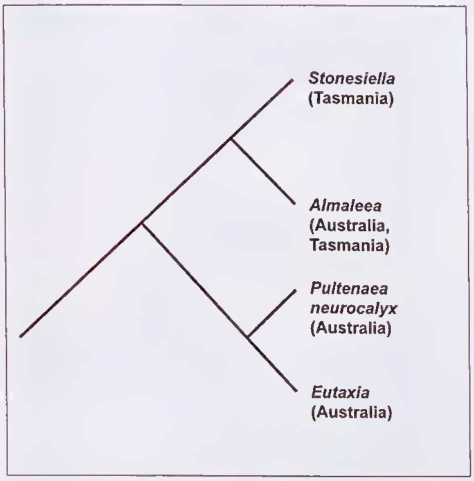


Fig. 21. Simplified tree derived from analysis of *trn*L-F sequences and morphology by Crisp *et al.* (1999a) which shows the position of *Stonesiella* and closely related taxa in the Fabaceae.

Fossil Record: None.

Habit and Ecology: *Stonesiella* is a shrub that grows to two metres and occurs in riparian habitat of closed heath, with other shrubs such as *Leptospermum, Melaleuca* and *Spyridium*, and emergent eucalypts, at low altitude below 300 m (Crisp *et al.* 1999a).

Distribution: About a thousand individual plants in eastern Tasmania (Fig. 22).

Remarks: *Stonesiella* is considered a neo-endemic and is interpreted as a recent segregate within this group. If taxonomic congruence is sought within this tribe then either large specious genera, like *Pultenaea*, may need to be split into smaller groups, or alternatively, monotypic genera, like *Stonesiella*, may need to be united with other taxa to form more meaningful taxonomic entities.

Fig. 22. Distribution of *Stonesiella.*

Haloragaceae *sensu lato*
Tetracarpaea Hook.f.

Monotypic genus – *T. tasmanica* Hook.f. (Fig. 17D).

Phylogenetic and Biogeographical Relationships: *Tetracarpaea* has been placed in various families, including the Cunoniaceae (Hooker 1857), Escalloniaceae (Curtis and Morris 1993), Grossulariaceae (Cronquist 1981) and its own family Tetracarpacaceae (Takhtajan 1997).

A recent molecular study using sequence data from five genes (*atp*B, *mat*K, *rbc*L, 18S, 26S nrDNA) placed *Tetracarpaea* in a clade which includes *Haloragis* and *Myriophyllum* (Haloragaceae *sensu stricto*), *Penthorum* and *Aphanopetalum* (Fishbein *et al.* 2001) (Fig. 23). Fishbein (pers. comm. 2002) proposed an expanded and broadly circumscribed family Haloragaceae *sensu lato* including *Aphanopetalum, Penthorum, Tetracarpaea* and Haloragaceae *sensu stricto*, which is accepted here.

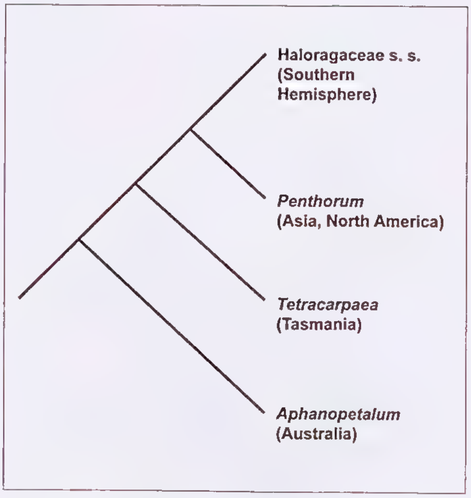


Fig. 23. Simplified tree derived from analysis of sequence data from five genes (chloroplast *atp*B, *mat*K, *rbc*L, and 18s and 26nrDNA) by Fishbein *et al.* (2001) which shows the phylogenetic relationships of *Tetracarpaea* within the Haloragaceae *sensu lato.*

Tetracarpaea is sister to the Haloragaceae *sensu stricto* and *Penthorum* (Fishbein *et al.* 2001; Savolainen *et al.* 2000). Haloragaceae are a cosmopolitan, but largely Southern Hemisphere family, and *Penthorum* is an Asian and North American genus (Mabberley 1987).

Fossil Record: None.

Habit and Ecology: *Tetracarpaea* is a shrub that grows to one metre, and occurs in heathland, occasionally in rainforest communities, montane forest and subalpine shrubbery from 200 to 1150 m a.s.l.

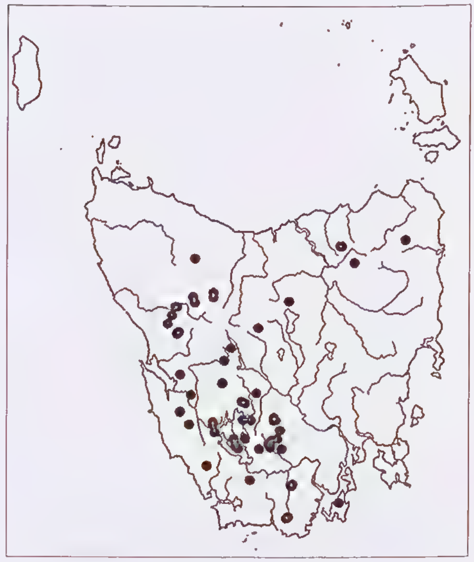


Fig. 24. Distribution of *Tetracarpaea.*

Distribution: Western Tasmania and the far south of the state, with a few records from north-eastern Tasmania (Fig. 24).

Remarks: The Haloragaceae *sensu lato* have a tetramerous perianth (except *Penthorum* which is 6-8-merous) (Fishbein pers. comm. 2002). *Tetracarpaea* differs from other genera in a broadly circumscribed Haloragaceae in having unitegmic ovules and hypogynous flowers (Fishbein pers. comm. 2002). *Tetracarpaea* is considered a palaeoendemic, based upon the long branch lengths identified in the molecular study that separate it from other genera in the family (Fishbein *et al.* 2001).

► **Fig. 25.** Photographs of Tasmanian endemic genera in the Malvaceae and Proteaceae.

A. *Asterotrichion discolor* in flower; note the indumentum on the under surface of the leaf. **B.** *Agastachys odorata*; note the typical habit and white inflorescences. **C.** *Bellendena montana*, in flower and fruit; this form of the plant is restricted to the basaltic soils of north western Tasmania. **D.** *Cenarrhenes nitida* in fruit.

Photographs supplied by Hans and Annie Wapstra.


A
B
C
D

As *Tetracarpaea* is sister to genera from both the Northern and Southern Hemisphere, a more detailed discussion of biogeographical relationships is not possible and estimates of age based upon vicariance are similarly not possible.

Malvaceae
Asterotrichion Klotzsch in Link, Klotzsch and Otto (1840)

Monotypic genus – *A. discolor* (Hook.) Melville (Fig. 25A).

Phylogenetic and Biogeographical Relationships: *Asterotrichion* was separated by Melville (1966) from related genera in the *Plagianthus* group (i.e. *Gynatrix, Hoheria, Lawrencia, Plagianthus* and *Selenothamnus*), based upon a reassessment of the morphological variation within this group. *Asterotrichion* differs from other genera in being exstipulate (other genera are stipulate and sometimes caducous), in the number of style branches, and in fruit characters. The phylogenetic significance of this morphological variation has not, however, been studied.

Tate *et al.*'s (2005) analysis of ITS sequence data in the tribe Malveae supported a strongly supported clade, the *Plagianthus* clade, with *Gynatrix* and *Asterotrichion* sister to *Plagianthus*, and all three genera are sister to *Hoheria* (Fig. 26). The *Plagianthus* clade, which includes *Gynatrix, Hoheria, Asterotrichion* and *Plagianthus,* is an Australian/New Zealand clade. Tate *et al.*'s analysis of ITS demonstrates that *Asterotrichion* is closely related to other genera in the *Plagianthus* group.

Analysis of ITS sequence data placed the *Plagianthus* clade in a larger moderately supported alliance with *Lawrencia, Sida hookeriana, S. hermaphrodita* and *Sidasodes colombiana* (Tate *et al.* 2005). *Selenothamnus* was not included in Tate *et al.*'s (2005) analysis. This alliance is largely a Southern Hemisphere group, with the exception of *S. hermaphrodita* (L.) Rusby which occurs in the eastern United States (Tate *et al.* 2005) (Fig. 26).

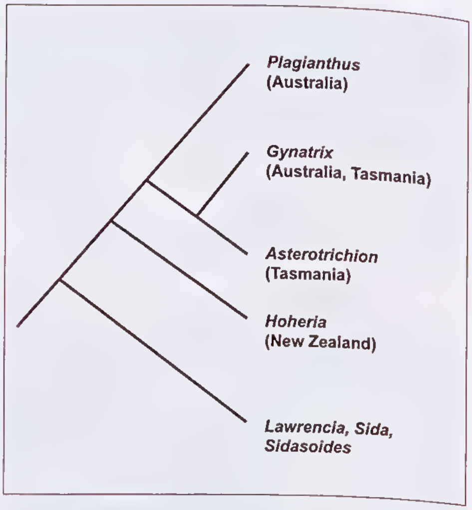


Fig. 26. Simplified tree derived from analysis of sequences from the ITS region of the 18S-26S nuclear ribosomal repeat by Tate *et al.* (2005) which shows the phylogenetic relationships of *Asterotrichion* within the *Plagianthus* clade.

Fossil Record: None.

Habit and Ecology: *Asterotrichion* is a shrub or small tree that grows to 10 m, and often occurs in riparian communities, or wet gullies from sea level to 700 m a.s.l.

Distribution: South-eastern Tasmania (Fig. 27).

Remarks: The ITS phylogeny showed that the generic limits within the tribe Malveae are unclear, and that the

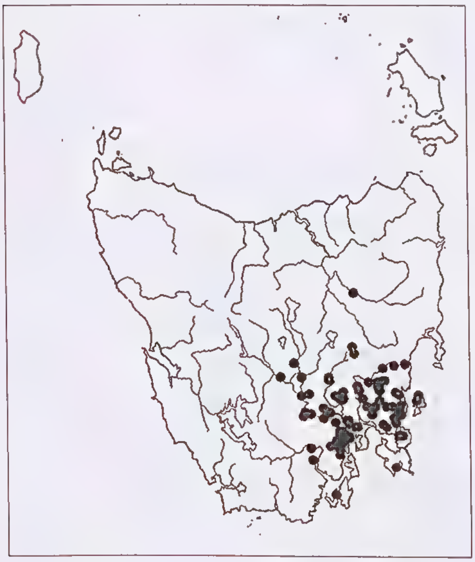


Fig. 27. Distribution of *Asterotrichion*.

nucleotide differences separating *Gynatrix*, *Asterotrichion* and *Plagianthus*, when compared with other genera in the tribe, are minimal (Tate *et al.* 2005). In the absence of a phylogenetic analysis of the morphological variation within the *Plagianthus* clade there is currently little support for recognising *Asterotrichion* as a separate genus. *Asterotrichion* is interpreted as a neoendemic.

Proteaceae
Agastachys R.Br.

Monotypic genus – *A. odorata* R.Br. (Fig. 25B).

Phylogenetic and Biogeographical Relationships: Characters that have been used to separate *Agastachys* from other closely related genera include a chromosome number of 13, and three angled indehiscent fruits that have two broad lateral wings and one narrow dorsal wing (Johnson and Briggs 1988). Johnson and Briggs (1975) assembled morphological, chemical and chromosome evidence to interpret the evolutionary relationships within the Proteaceae, and thereby derived a classification for the family. Their analysis placed *Agastachys* in the subfamily Proteoideae, closely related to *Symphionema* and *Cenarrhenes*.

Analysis of *atp*B and *atp*B-*rbc*L intergenic spacer region sequences (Hoot and Douglas 1998) and a combined analysis using the available molecular phylogenies Jordan *et al.* (2005) and Weston and Barker (2006) place *Agastachys* as sister to the mainland Australian genus, *Symphionema*, and this clade is sister to all other genera in the Proteoideae. *Agastachys* and *Symphionema* were placed in the subfamily Symphionematoideae by Weston and Barker (2006).

Fossil Record: The oldest macrofossils of *Agastachys* are from the Early Pleistocene deposits at Regatta Point in Tasmania (Jordan *et al.* 1998). Fossil pollen, which has been described as the *Agastachys*-type, is recorded from the Late Paleocene onwards in Australia (Macphail *et al.* 1994). It would, however, be misleading to attribute all of these fossil pollen records to an extant genus.

Habit and Ecology: *Agastachys* is a shrub that grows to 3 m high, and occurs in a variety of plant communities, including *Gymnoschoenus* sedgeland, shrubby heathland, occasionally in rainforest and open forest, and in subalpine shrub and herb fields from sea level to 1000 m a.s.l.

Distribution: Western Tasmania and the far south of the state (Fig. 28).

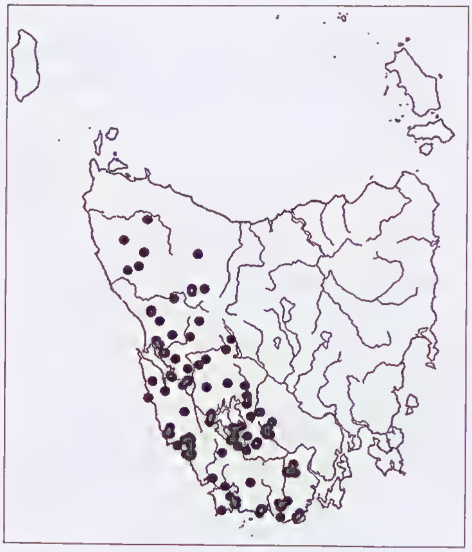


Fig. 28. Distribution of *Agastachys*.

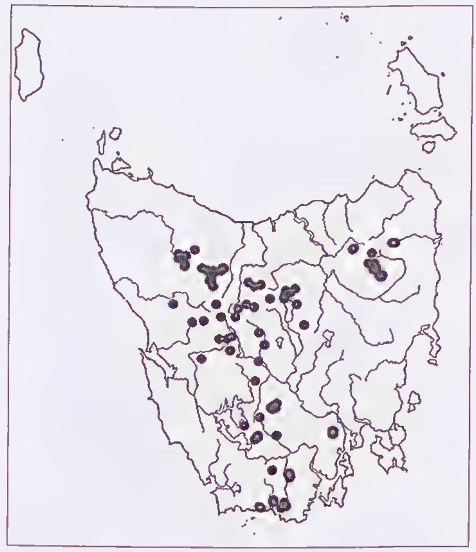


Fig. 29. Distribution of *Bellendena*.

Remarks: *Agastachys* and *Symphionema* are interpreted as a palaeoendemics, and the subfamily is restricted to the Australian region.

Bellendena R.Br.

Monotypic genus – currently one morphologically variable species, *B. montana* R.Br. (Fig. 25C).

Phylogenetic and Biogeographical Relationships: *Bellendena* has a number of plesiomorphic features, including free parted flowers (i.e. free filaments and no fusion between tepals) and a lack of nectaries (hypogynous glands) (Venkata Rao 1971; Johnson and Briggs 1975). Johnson and Briggs (1975) suggested that *Bellendena* was a basal member of the Proteaceae.

Putative autapomorphies that separate *Bellendena* from all other genera in the Proteaceae include a chromosome number of 5, the absence of floral bracts, and the possession of winged fruits (Johnson and Briggs 1975, Weston and Barker 2006). The subsidiary cell arrangement in the leaves of *Bellendena* is also distinct from other genera in the Proteaceae (Carpenter *et al.* 2005).

An analysis of *atp*B and *atp*B-*rbc*L intergenic spacer region sequences indicated that *Bellendena* was isolated from other genera of Proteaceae, supporting its placement in its own subfamily Bellendenoideae (Hoot and Douglas 1998). A combined analysis of available molecular phylogenies (Jordan *et al.* 2005, Weston and Barker 2006), supports a basal position for *Bellendena*, isolated from other genera in the Proteaceae. *Bellendena* is sister to the rest of the family (Jordan *et al.* 2005) or sister to the Persoonioideae (Weston and Barker 2006), so further resolution of its biogeographical relationships is not possible.

Fossil Record: None.

Habit and Ecology: *Bellendena* is a shrub and occurs in alpine and subalpine communities, and in subalpine *Eucalyptus* forest, rarely in *Nothofagus* rainforest, from 500 m to 1500 m a.s.l.

Distribution: Montane areas in central Tasmania, high elevation areas of NE Tasmania (e.g. Ben Lomond) and the far south of the state (Fig. 29).

Remarks: *Bellendena* is phylogenetically isolated and is interpreted as a palaeo-endemic. As it is not possible to resolve the biogeographical relationships between *Bellendena* and these other genera, estimates of age based upon vicariance are similarly not possible.

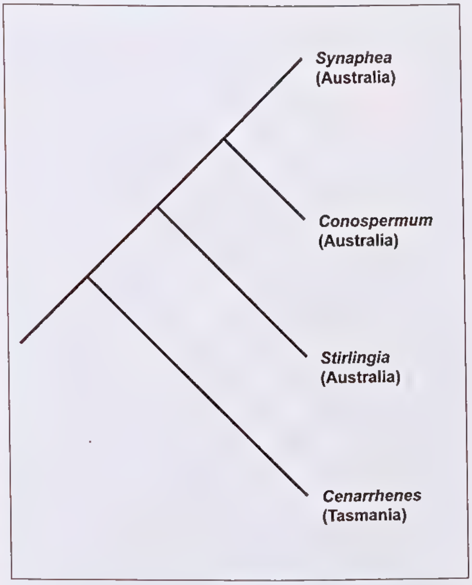


Fig. 30. Simplified tree derived from analysis of *atp*B and *atp*B-*rbc*L intergenic spacer region sequences by Hoot and Douglas (1998) which shows the phylogenetic relationships of *Cenarrhenes* to closely related genera in the Proteoideae (Proteaceae).

Cenarrhenes Labill.

Monotypic genus – *Cenarrhenes nitida* Labill. (Fig. 25D).

Phylogenetic and Biogeographical Relationships: *Cenarrhenes* is placed in the subfamily Proteoideae based upon morphological characters including the presence of dry indehiscent fruits and floral bracts (Johnson and Briggs 1975, 1988). It differs from other genera in the Proteoideae in having a drupaceous fruit, one of the anthers has a long terminal awn (which is absent in other genera), and in the possession of floral glands (Johnson and Briggs 1975, 1988).

Analysis of sequence data from *atp*B and *atp*B-*rbc*L intergenic spacer region also placed *Cenarrhenes* in the Proteoideae (Hoot and Douglas 1998). Analyses of ITS sequence data similarly places it in the Proteoideae (Weston and Barker 2006). The Proteoideae are represented by genera in Australia, southern Africa, Madagascar and New Caledonia, but *Cenarrhenes* is part of an Australian clade, and is sister to the Australian genera, *Stirlingia, Conospermum* and *Synaphea* (Hoot and Douglas 1998; Weston and Barker 2006) (Fig. 30).

Fossil Record: The oldest fossils of *Cenarrhenes* are from the Early Pleistocene Regatta Point locality in Tasmania (Jordan *et al.* 1998). *Cenarrhenes* was also recorded from the Middle–Late Eocene in Tasmania (Pole 1992); but a more recent study by Carpenter and Jordan (1997), however,

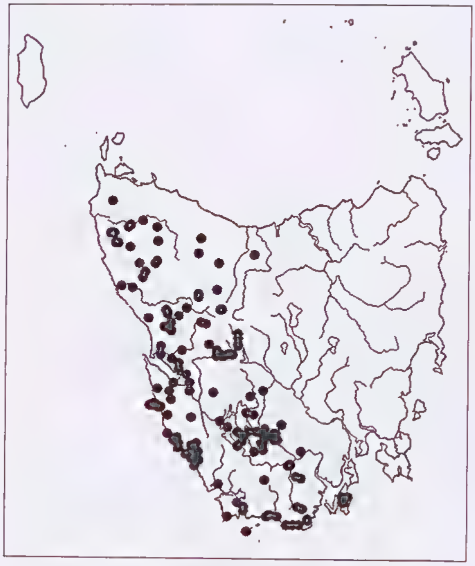


Fig. 31. Distribution of *Cenarrhenes.*

suggested that it could not be referred to that genus with certainty.

Habit and Ecology: *Cenarrhenes* is a tree that grows to six metres, and occurs in thamnic rainforest communities, sedgeland heath, and occasionally in subalpine shrubbery, from sea level to 1130 m a.s.l.

Distribution: Western Tasmania and the far south of the state (Fig. 31).

Remarks: *Cenarrhenes* is interpreted as a palaeoendemic, and this clade is restricted to the Australian region.

MONOCOTYLEDONS
Asteliaceae
Milligania Hook.f.

Five species – *M. densiflora* Hook.f., *M. johnstonii* F.Muell. ex Benth., *M. lindoniana* Rodway, *M. longifolia* Hook.f., *M. stylosa* F.Muell. ex Hook.f. (Fig. 32A).

Phylogenetic and Biogeographical Relationships: The family Asteliaceae includes *Astelia, Collospermum, Neoastelia* and *Milligania* (Rudall *et al.* 1998). *Milligania* is separated from other genera in the family by a group of characters including: hermaphrodite flowers (dioecious or gynodioecious in *Astelia, Collospermum,* and *Neoastelia*); filaments basally adnate to tepals (free in other genera); loculicidal capsule (berry in other genera); and mucilage canals absent from the leaves (present in other genera) (Rudall *et al.* 1998).

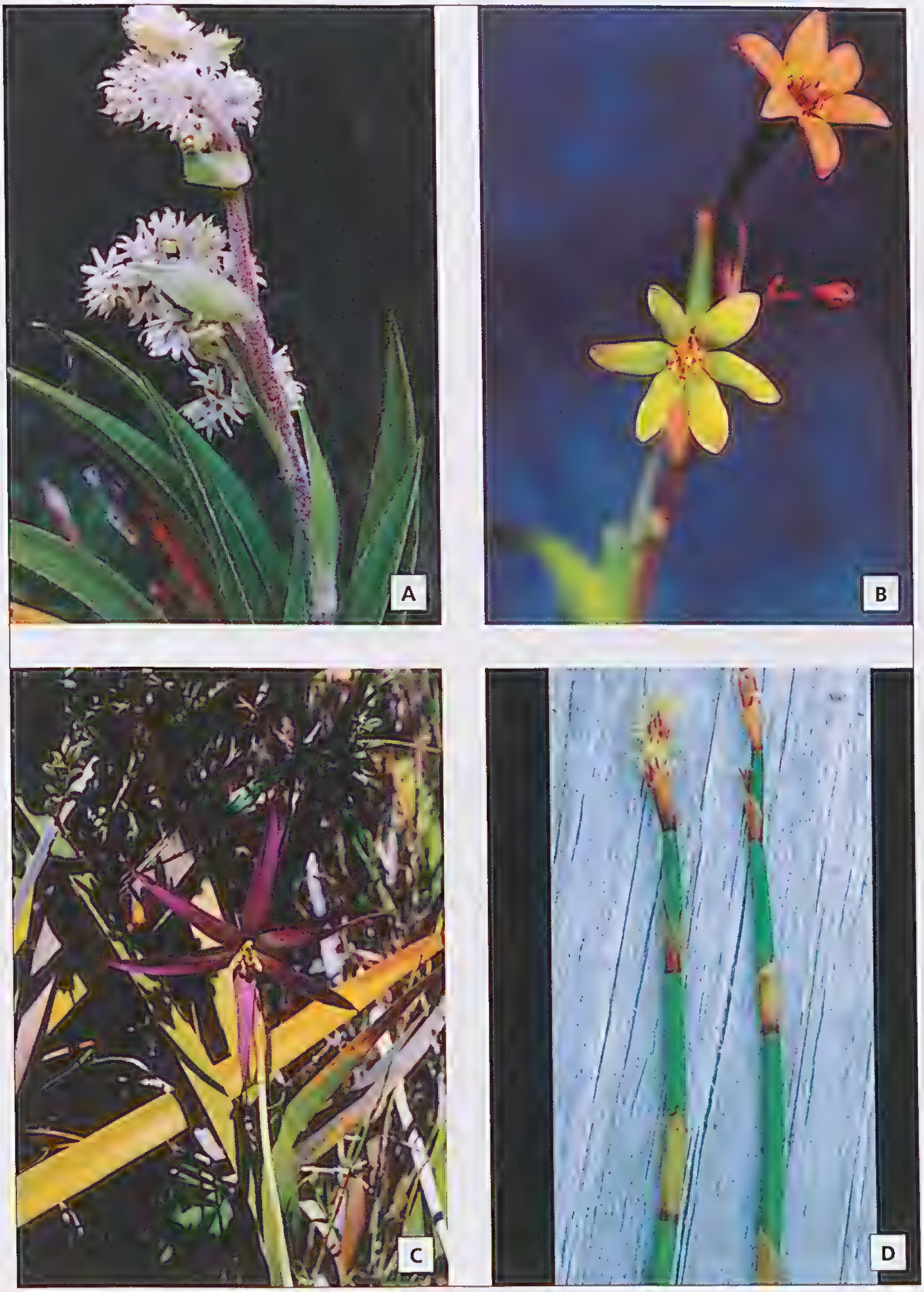
Milligania is sister to the other genera in the Asteliaceae on both morphological and molecular (*rbc*L) grounds (Rudall *et al.* 1998) (Fig. 33). Rudall *et al.* (1998) also noted that the generic delimitation within *Astelia, Neoastelia* and *Collospermum* needed reassessment.

The Asteliaceae are a Southern Hemisphere family. *Astelia* occurs in New Zealand, Australia, other islands of the Pacific, Chile and the Mascarenes; *Neoastelia* is restricted to mainland Australia (New South Wales), and *Collospermum*

▸ **Fig. 32.** Photographs of selected Tasmanian endemic monocot genera.

A. *Milligania densiflora,* in flower. **B.** *Campynema lineare*; note the typical yellow green colour of the flower at anthesis and more distal, older, brownish-purple, senescent flower. **C.** *Isophysis tasmanica*; note the typical dark-brown, purple colour of the flower. **D.** *Winifredia sola,* showing typical form of the plant.

PHOTOGRAPHS A–C SUPPLIED BY HANS AND ANNIE WAPSTRA, D BY GREG JORDAN.


A
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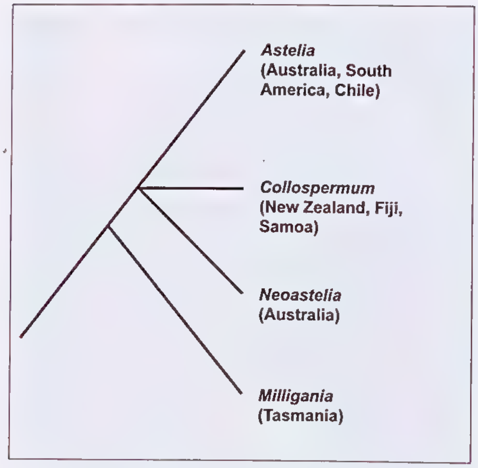

Fig. 33. Simplified tree derived upon analysis of morphological and *rbc*L sequence data by Rudall *et al.* (2000) which shows the phylogenetic relationships of *Milligania* to other genera in the Asteliaceae.

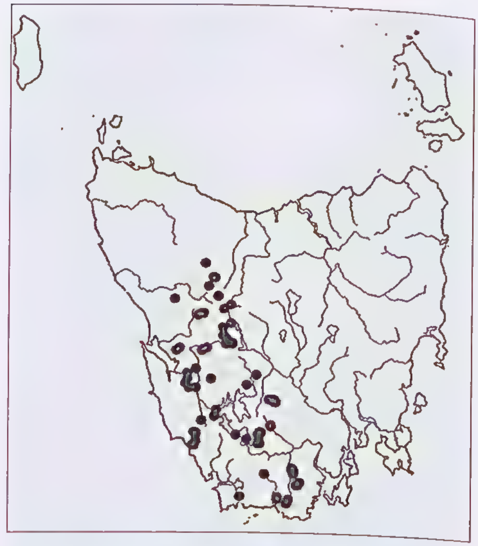

Fig. 34. Distribution of *Milligania*.

occurs in New Zealand, Fiji and Samoa (Rudall *et al.* 1998). As *Milligania* is sister to the rest of the family no further resolution of biogeographical relationships is possible (Fig. 33).

Fossil Record: There are no fossil records of *Milligania*. The oldest records of a distinctive echinate monocolpate pollen, which have been referred to *Astelia*, are from the late Eocene in New Zealand (Macphail *et al.* 1994). It is therefore logical to assume that *Milligania*, which is sister to *Astelia*, *Neoastelia* and *Collospermum*, had also evolved by this time.

Habit and Ecology: *Milligania* is a lily-like plant that occurs in differing plant communities from coastal alkaline pans with *Winifredia*, to alpine heath, herb and cushion plant communities, on cliff edges, and around waterfalls, from near sea level to 1540 m a.s.l.

Distribution: Western Tasmania and montane areas in the far south of the state (Fig. 34).

Remarks: The fossil pollen evidence suggests a pre Late Eocene origin for this clade, and *Milligania* is interpreted as a palaeoendemic. As it is not possible to resolve the biogeographical relationships between these genera, estimates of age based upon vicariance are not possible.

Campynemataceae
Campynema Labill.

Monotypic genus – *C. lineare* Labill. (Fig. 32B)

Phylogenetic and Biogeographical Relationships: Two genera, *Campynema* and *Campynemanthe* (New Caledonian genus of three species) are placed in the Campynemataceae (Goldblatt 1986). *Campynema* can be distinguished from

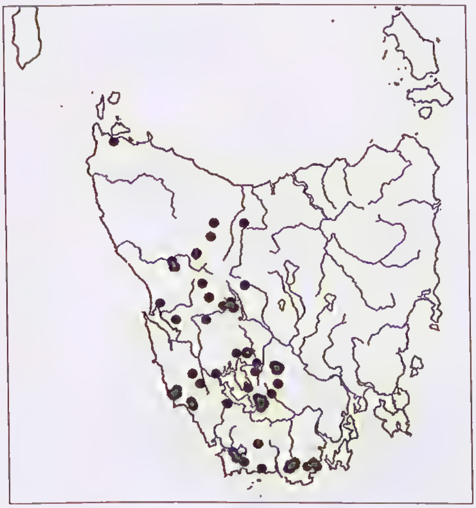

Fig. 35. Distribution of *Campynema.*

Campynemanthe by usually its single flowered botryoid inflorescence (pseudo-umbellate inflorescence in *Campynemanthe*) and single basal leaf (rosulate in *Campynemanthe*) (Kubitzki 1998).

A cladistic analysis of morphological data, examined phylogenetic relationships within the Liliales and supported the placement of both genera in their own family (Rudall *et al.* 2000). Further analyses of morphological data (Rudall *et al.* 2000) and *rbc*L sequence data (Vinnersten and Bremer 2001) confirm that *Campynema* is sister to the New Caledonian genus *Campynemanthe.*

Fossil Record: None.

Habit and Ecology: *Campynema* is a lily-like plant that occurs in lowland sedge-dominated communities on peat, as an understorey herb in heathland, and is most commonly collected in alpine herbfield or heath, from sea level to 1350 metres a.s.l.

Distribution: Western Tasmania (Fig. 35).

Remarks: *Campynema* is interpreted as a palaeoendemic. A Cretaceous origin would be inferred for the *Campynema/Campynemanthe* clade if vicariance were invoked to explain their disjunct distribution in Tasmania and New Caledonia respectively.

Iridaceae
Isophysis T.Moore

Monotypic genus – *I. tasmanica* (Hook.) T. Moore (Fig. 32C)

Phylogenetic and Biogeographical Relationships: *Isophysis* is placed in the Iridaceae based upon characters such as a single whorl of three stamens and having styloid (calcium oxalate) crystals and also isobilateral leaves (Goldblatt 1990, 1998; Rudall 1995; Reeves *et al.* 2001). It is separated from other genera in the family by having a superior ovary (inferior in other genera), flowers without nectaries (septal or perigonal nectaries in the rest of the family) and an inflorescence consisting of a single flower (usually the inflorescence is a spike or rhipidium in other genera) (Goldblatt 1990). Molecular studies based upon *rbc*L data and *trn*L-F sequences indicate that *Isophysis* is sister to the rest of Iridaceae (Reeves *et al.* 2001) and would support it being placed in its own subfamily Isophysidoideae (Goldblatt 1990).

The Iridaceae are placed within the lower asparagoids, a clade including the Doryanthaceae and Ixiolirionaceae, with Tecophilaeaceae (including Cyanastreaceae) as a sister group based upon *rbc*L data and morphology (Chase *et al.* 1995; Chase *et al.* 2000; Fay *et al.* 2000; Rudall *et al.* 1997). As both the Iridaceae and other lower asparagoids possess an inferior ovary, the superior ovary in *Isophysis* has evolved

Fig. 36. Distribution of *Isophysis*.

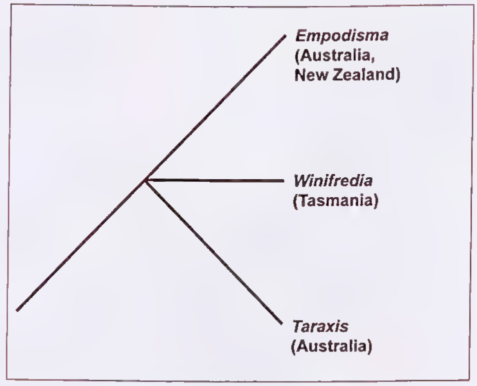

Fig. 37. Simplified tree based upon chloroplast DNA sequence data (*rbc*L, *trn*L intron, and *trn*L-*trn*F intergenic spacer) which shows the phylogenetic relationships of *Winifredia* in the *Winifredia* clade (Restionaceae).

independently and is an autapomorphy (Reeves *et al.* 2001). The Iridaceae are a widespread and essentially cosmopolitan family, with many species in southern Africa, eastern Mediterranean and Central and South America (Mabberley 1987).

Fossil Record: None.

Habit and Ecology: *Isophysis* is an iris-like plant that occurs in alpine herbfields and heathland/sedgeland on skeletal quartzite soils, and less commonly on lowland button grass (*Gymnoschoenus*) moorland, from near sea level to 1400 m a.s.l.

Distribution: Western Tasmania and the far south of the state (Fig. 36).

Remarks: *Isophysis* is sister to the rest of the family, and it is considered a palaeoendemic. As it is not possible to resolve the biogeographical relationships between *Isophysis* and these other genera, estimates of age based upon vicariance are similarly not possible.

Restionaceae
Winifredia L.A.S.Johnson and B.Briggs

Monotypic genus – *W. sola* L.A.S.Johnson and B.Briggs (Fig. 32D)

Phylogenetic and Biogeographical Relationships: Morphological analyses recognised *Winifredia* as being somewhat isolated and difficult to compare morphologically with other genera because it possesses a suite of plesiomorphic characters (Linder *et al.* 2000; Briggs *et al.* 2000). Molecular studies using chloroplast DNA sequence data (*rbc*L, *trn*L intron and *trn*L-F intergenic spacer) placed it in a clade with *Empodisma* and *Taraxis*, and this clade is a relatively early offshoot in the family (Fig. 37) (Briggs *et al.* 2000). *Winifredia* forms a trichotomy with the other two genera (Briggs *et al.* 2000), and in a more recent paper using combined data from *rbc*L, *trn*L-F sequences in a reweighted total evidence tree (Linder *et al.* 2003) it is sister to both genera.

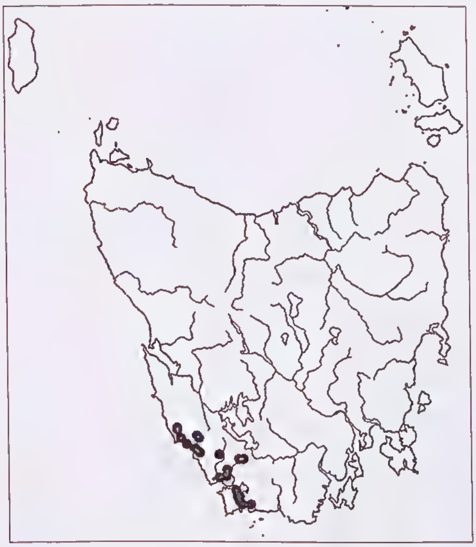

Fig. 38. Distribution of *Winifredia*.

The Restionaceae are a Southern Hemisphere family largely restricted to Australia and South Africa. *Winifredia* along with the taxon, *Empodisma* (mainland Australia, Tasmania and New Zealand), and *Taraxis grossa* B.Briggs & L.A.S.Johnson from south-west Western Australia form a southern Australian/New Zealand clade (Fig. 37).

Fossil Record: None.

Habit and Ecology: *Winifredia* is a rhizomatous sedge-like plant that occurs in button grass (*Gymnoschoenus*) moorland, in seasonally inundated heath and swamps, usually on a peat substrate from sea level to 180 m a.s.l.

Distribution: South-western corner of Tasmania (Fig. 38).

Remarks: The clade that includes *Winifredia* is a relatively early offshoot within the family and there is little evidence currently available to interpret the genus as either a paleoendemic or neoendemic. This clade includes *Empodisma*, which includes two species occurring in mainland Australia, Tasmania and New Zealand. The presence of *Empodisma minus* (J.D.Hooker) L.A.S.Johnson and D.F.Cutler in both New Zealand and Australia is thought to be attributable to long-distance dispersal, rather than vicariance (Linder *et al.* 2003).

DISCUSSION

Tasmania's endemics include trees, shrubs or undershrubs and herbs. Nineteen endemic genera are currently recognised for Tasmania and are placed in twelve families. These families (with the number of genera in parentheses) are recognised as either Gondwanic families, e.g. Asteliaceae (1), Cunoniaceae (1), Campynemataceae (1), Haloragaceae (1), Podocarpaceae (2), Proteaceae (3), Restionaceae (1), or the endemic genera occur in Southern Hemisphere clades in cosmopolitan families e.g. Asteraceae (2), Cupressaceae (2), Ericaceae (2), Fabaceae (1), Iridaceae (1) and Malvaceae (1). Sixteen genera are monospecific (84%) with the remaining three taxa *Athrotaxis*, *Planocarpa* and *Milligania* having two, three and five species respectively.

Ecology of the endemic genera

Jordan (1995) recognised two broad biogeographical regions, western and eastern Tasmania, which are separated by both edaphic and climatic factors, including the 1000 mm annual isohyet. Most of the endemic genera occur in

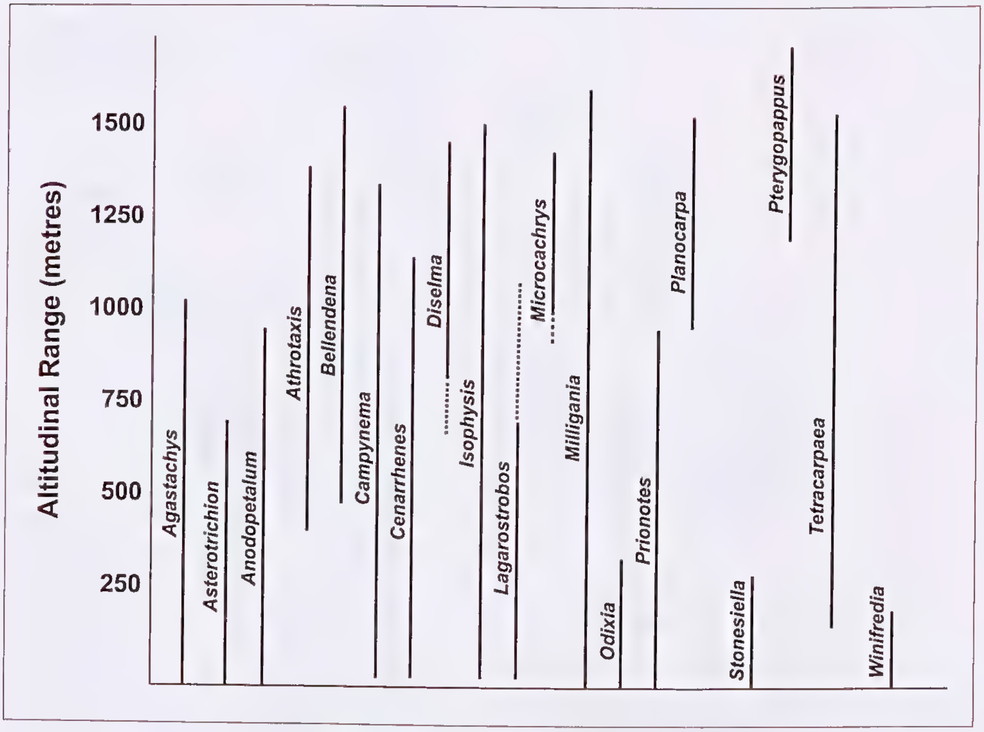

Fig. 39. Altitudinal range of Tasmania's endemic genera.

western Tasmania, with two, *Bellendena* and *Tetracarpaea,* also occurring in montane, high rainfall areas (above 1000 mm) in north-eastern Tasmania (Figs 24, 29). Three genera (*Asterotrichion, Odixia* and *Stonesiella*) are restricted to eastern Tasmania.

The superficial geology of Tasmania can be divided into two broad regions. Mesozoic dolerites and sedimentary units are the major rock types in the eastern half of the state, while Precambrian to Ordovician sediments and metasediments outcrop commonly in the western half of Tasmania. The geology, however, is considerably more complex (Reid *et al.* 1999, Fig. 18), and most genera in western Tasmania occur on a range of rock and soil types.

Genera that are largely restricted to dolerites include *Bellendena, Microcachrys* and *Pterygopappus,* although *Microcachrys* also occurs on Cambrian volcanics of Mt Read (G. Jordan pers. comm. 2006). A second group are acidophiles, e.g. *Agastachys, Isophysis* and *Winifredia,* and occur on the quartzites, conglomerates, sandstones and sandy soils of western Tasmania. Some species of *Planocarpa* and *Milligania* are restricted to specific rock types, e.g. either calcareous sediments or dolerites.

The altitudinal range is quite variable and seven genera, including *Agastachys, Cenarrhenes, Campynema, Lagarostrobos,* *Milligania, Prionotes* and *Tetracarpaea,* occur from near sea level to 1000 m (Fig. 39). *Planocarpa, Pterygopappus* and *Microcachrys* have a restricted altitudinal ranges and only occur above 900 m. *Winifredia* is a lowland plant that usually occurs in moorland below 200 m. The three genera (*Asterotrichion, Odixia* and *Stonesiella*) that are restricted to eastern Tasmania occur below 700 m.

The endemic genera occur in rainforest, alpine and montane heathland/*Eucalyptus* communities. Genera that often occur in rainforest include *Anodopetalum, Athrotaxis, Cenarrhenes, Diselma, Lagarostrobos, Prionotes, Agastachys* and *Tetracarpaea,* although the latter two genera can also occur in open *Eucalyptus* forest. *Agastachys* and *Cenarrhenes* also occur in button grass moorland. Rainforest in Tasmania has been classified, by Jarman *et al.* (1994), into three broad types: implicate, thamnic and open montane rainforest. Taxa that are largely restricted to implicate rainforest include *Prionotes* and *Tetracarpaea* (Jarman *et al.* 1994). *Anodopetalum, Athrotaxis selaginoides, Cenarrhenes* and *Lagarostrobos* occur in both thamnic and implicate rainforest communities (Jarman *et al.* 1994) and *Athrotaxis cupressoides* is a key indicator species for open montane rainforest (Jarman *et al.* 1994). *Diselma* occurs in both open montane rainforest and implicate rainforest communities.

During the Last Glacial the distribution of rainforest was interpreted by Kirkpatrick and Fowler (1998) as being restricted to lower altitudes and in sheltered valleys that acted as refugia. Most of the endemic rainforest genera are quite widespread, have significant altitudinal ranges and occur in a range of plant communities (*sensu* Kirkpatrick *et al.* 1995). The current widespread distribution of most of these genera would suggest that scattered refugia existed throughout western Tasmania during the Last Glacial.

Some common distributional patterns within other rainforest genera in Tasmania have, however, been interpreted as providing evidence of discrete refugia. Barnes *et al.* (2000) interpreted that the differences in leaf morphology in two rainforest species (*Tasmannia lanceolata* (Poiret) A.C.Smith and *Eucryphia milliganii* Hook.f.) could possibly be due to small populations of these species becoming isolated during the Last Glacial. They postulated that there was a subsequent divergence in morphology in these isolated populations, and that this is still evident in the modern distribution of these species.

Genera that often occur in alpine and subalpine communities are *Campynema, Diselma, Bellendena, Isophysis, Microcachrys, Milligania, Planocarpa* and *Pterygopappus.* The alpine communities in Tasmania do not show the clear cut altitudinal bands as seen in the European Alps (Crowden 1999), and most genera occur in a range of plant communities (*sensu* Kirkpatrick *et al.* 1995). Kirkpatrick and Fowler (1998) postulated that with cooler climatic conditions alpine communities were more widespread during the last glacial. The reduction of alpine communities since the Last Glacial, and the accumulating evidence for global warming, make these alpine communities among the most threatened plant communities in the state, because there is no capacity for dispersal.

Winifredia is a moorland genus that occurs in button grass (*Gymnoschoenus*) moorland communities. Although most species of *Milligania* occur in alpine communities, *M. johnstonii* also occurs in button grass communities at low altitude. The lowland habitat, occupied by *Winifredia* and this species of *Milligania*, was interpreted as a glacial refugium by Kirkpatrick and Fowler (1998).

Stonesiella, *Asterotrichion* and *Odixia* are restricted to eastern Tasmania and occur in low rainfall areas (with less than 1000 mm/annum) and at relatively low altitudes, i.e. usually less than 700 m, with the latter two genera often occurring in riparian habitats.

Evolutionary and biogeographical relationships

DNA phylogenies are available for all of the Tasmanian genera and these studies have aimed to elucidate the phylogenetic relationships within particular families. This review shows that an understanding of the evolutionary history of Tasmania's endemic genera requires the analysis of sequence data from both slowly (e.g. *rbc*L, *atp*B) and more rapidly evolving regions of DNA (e.g. ETS, *atp*B–*rbc*L intergenic region, *mat*K) (Table 1). The range of sequence data used suggests that no singular pattern can explain the phylogenetic and biogeographical relationships of Tasmania's endemic genera, because the flora includes both old relictual taxa and more recently evolved genera.

The phylogenetic position of the endemic genera was mapped onto the angiosperm phylogeny of Soltis *et al.* (2005) (Fig. 40). Seven genera are in the 'Core Eudicots' (four asterids, three rosids), three genera (all Proteaceae) were 'Early-diverging Dicots', and the remaining genera are 'Basal Angiosperms' (all monocots). The major angiosperm clades, in declining order of numbers of endemic genera/species, are the asterids (4/150), monocots (4/130), rosids (3/85), Proteales (3/17), Ranunculales (0/10), (Fig. 40). The conifers (4/8) are clearly anomalous in the large number of endemic genera and species that persist in Tasmania.

In Tasmania, two groups of endemic genera are identified, i.e. palaeoendemics and neoendemics, which differ in their distribution, habitat, inferred age and phylogenetic history. These groups are largely restricted to discrete floristic biomes (*sensu* Crisp *et al.* 2004). The palaeoendemics only occur in the aseasonal-wet biome, which is largely restricted to the western half of Tasmania and is exemplified by cool temperate rainforest (Schodde 1989; Hill *et al.* 1999; Crisp *et al.* 2004). The neoendemics generally occur in the south-eastern temperate biome (Crisp *et al.* 2004) = Bassian element (*sensu* Schodde 1989), which typically includes eucalypt woodland, and is restricted to the eastern half of the state.

Schodde (1989) considered the aseasonal-wet biome, which he referred to as the Tumbunan element, as ancestral to the autochthonous biota of the Torresian, Bassian and Eyrean elements of Australia, i.e. largely the dry-adapted flora of the rest of the continent. It is generally inferred, particularly from the fossil pollen record, that humid mesic forests existed in Gondwana from the Late Cretaceous to the mid-Tertiary (Hill *et al.* 1993b, 1999; Nelson 1981; Schodde 1989). The macrofossil evidence of rainforest genera, like *Athertonia* (Proteaceae) (Rozefelds 1992), *Ceratopetalum* (Cunoniaceae) (Barnes

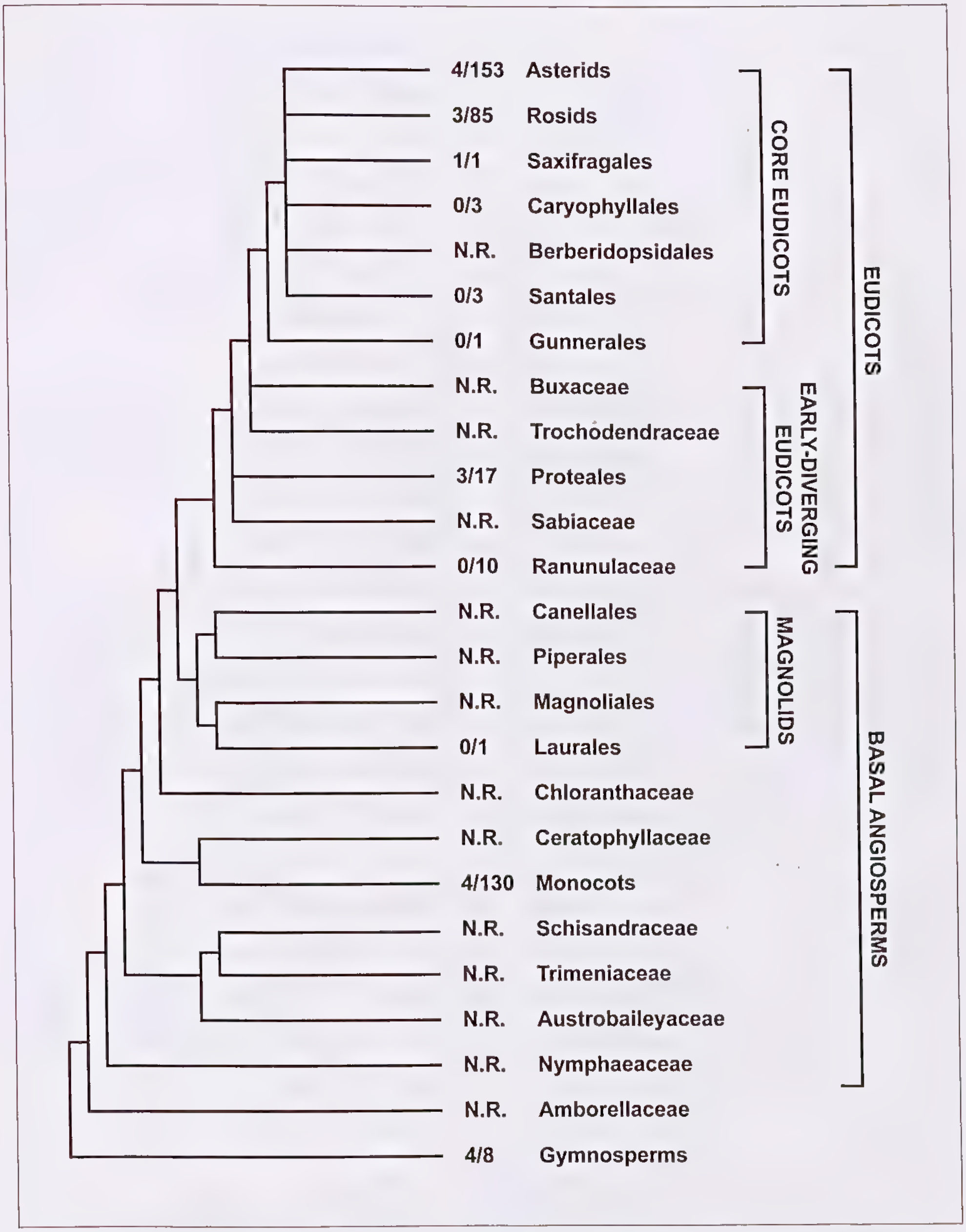

Fig. 40. The distribution of the endemic genera of Tasmania is mapped unto the angiosperm phylogeny of Soltis *et al.* (2005). The number of endemic genera/endemic species associated with each clade is also indicated. The estimate of number of species is from Buchanan (2005). Clades with no indigenous species in Tasmania are indicated by N.R.

	Family	*n*	Sister taxon/clade	Distribution of Sister taxon	Reference
PALAEOENDEMICS					
CONIFERS					
Athrotaxis D.Don	Cupressaceae	2	Large clade including Northern and Southern Hemisphere subfamilies	Not resolvable	Gadek *et al.* 2000
Diselma Hook.f.	Cupressaceae	1	*Fitzroya*	South America	Gadek *et al.* 2000
Lagarostrobos C.J.Quinn	Podocarpaceae	1	*Manoao*	New Zealand	Conran *et al.* 2000
Microcachrys Hook.f.	Podocarpaceae	1	*Pherosphaera*	Southern Australia including Tasmania	Conran *et al.* 2000; herein
ANGIOSPERMS					
Agastachys R.Br.	Proteaceae	1	*Symphionema*	Southern Australia	Hoot and Douglas 1998; Weston and Barker 2006
Anodopetalum A.Cunn. ex Endl.	Cunoniaceae	1	*Platylophus*	Southern Africa	Bradford and Barnes 2001
Bellendena R.Br.	Proteaceae	1	The Proteaceae generally or the subfamily Persoonioideae	Not resolvable	Hoot and Douglas 1998; Weston and Barker 2006
Campynema Labill.	Campynemataceae	1	*Campynemanthe*	New Caledonia	Rudall *et al.* 2000
Cenarrhenes Labill.	Proteaceae	1	A clade including *Stirlingia*, *Conospermum* and *Synaphea*	Australia	Hoot and Douglas 1998; Weston and Barker 2006

Isophysis Hook.f.	Iridaceae	1	The remaining genera in the family	Not resolvable	Reeve *et al.* 2001
Milligania Hook.f.	Asteliaceae	5	The remaining genera in the family	Not resolvable	Rudall *et al.* 2000
Planocarpa Weiller	Ericaceae	3	Relationships with other groups of genera are not resolved	Australia?	Quinn *et al.* 2003
Prionotes R.Br	Ericacaeae	1	*Lebetanthus*	South America	Crayn *et al.* 1998
Tetracarpaea Hook.f.	Haloragaceae s.l.	1	Haloragaceae *s.s.*	Not resolvable	Fishbein *et al.* 2001
NEOENDEMICS					
Asterotrichion Klotsch	Malvaceae	1	*Gynatrix*, but generic limits unclear	Southern Australia including Tasmania and New Zealand	Tate *et al.* 2005
Odixia Orch.	Asteraceae	2	*Ozothamnus diosmifolius*, but generic limits unclear	Southern Australia	Bayer *et al.* 2002
Stonesiella Crisp and P.H.Weston	Fabaceae	1	*Almaleea*, but generic groupings may require further revision	Australia	Crisp *et al.* 1999
STATUS OF ENDEMICITY UNCERTAIN					
Pterygopappus Hook.f	Asteraceae	1	A clade including *Ewartia*, *Stuartina*, *Ozothamnus* spp. and *Acanthocladium*	Australia	Bayer *et al.* 2002
Winifredia L.A.S.Johnson & B.Briggs	Restionaceae	1	Polytomy with *Empodisma* and *Taraxis*	Australia	Briggs *et al.* 2000; Linder *et al.* 2003

Table 2. The endemic genera of Tasmania, respective family and sister taxon and the distribution of sister taxon. Five genera, *Athrotaxis*, *Bellendena*, *Isophysis*, *Milligania* and *Tetracarpaea* are sister to large taxonomic groups and their biogeographical relationships therefore cannot be resolved.

et al. 2001; Rozefelds and Barnes 2002), *Eidothea* (Proteaceae) (Rozefelds *et al.* 2005); *Elaeocarpus* (Elaeocarpaceae) (Rozefelds and Christophel 2002 and references therein), *Gymnostoma* (Casuarinaceae) (Hill 1994; Scriven and Hill 1995), *Nothofagus* (Nothofagaceae) (Hill 1994; Swenson *et al.* 2001 and references cited therein) and *Vesselowskya* (Cunoniaceae) (Barnes *et al.* 2001) that are largely restricted to the aseasonal-wet biome, also provide support for this interpretation.

Most of Tasmania's palaeoendemics are restricted to rainforest communities and appear to have evolved from these Late Cretaceous – Early Tertiary floras, and this date is supported by estimates of age based upon vicariance (see below). Lowry (1991) similarly interpreted the New Caledonian flora as consisting of two elements, which included an ancient 'Australasian' component which he interpreted as having a Late Cretaceous – Early Tertiary origin.

Three informal groupings of palaeoendemics are recognised herein. One group (approximately 26% of genera) includes *Athrotaxis, Bellendena, Isophysis, Milligania* and *Tetracarpaea*. These genera are so phylogenetically isolated that their biogeographical relationships cannot be currently resolved, and estimates of age based upon vicariance are not possible. These genera (with the exception of *Milligania*) are currently placed, or could be placed as is the case for *Tetracarpaea*, in their own subfamily.

A second group (approximately 26% of genera) has discrete, but distant biogeographical linkages with either New Zealand (*Lagarostrobos*), southern Africa (*Anodopetalum*), South America (*Diselma, Prionotes*) and New Caledonia (*Campynema*). These biogeographical linkages can be explained through either long-distance dispersal and/or vicariance.

Recent divergence time analyses of species of *Nothofagus* (Knapp *et al.* 2005) and *Aristotelia* (Elaeocarpaceae) (Crayn *et al.* 2006) have been interpreted as evidence for long-distance dispersal from Australia to New Zealand. Similarly, although most species of *Adansonia* (Bombacaceae) occur in southern Africa and Madagascar, a single species occurs in Western Australia, and Baum *et al.* (1998) have also argued that long-distance dispersal, rather than vicariance, is the most likely explanation for the occurrence of this genus in Australia.

Cook and Crisp (2005) pointed out that the formation of the Southern Ocean was initiated after the rifting of South America and Australia from Antarctica, around 38 My B.P. (Veevers *et al.* 1991). With the gradual rafting northwards of the Australian plate, that includes Tasmania, the Circum-Antarctic Current, and prevailing westerly wind flow, are likely to have commenced around 30 My B.P. (Kennett *et al.* 1974). The prevailing westerly wind flow explains the westward dispersal of floristic elements the current 2000 km from Australia to New Zealand (e.g. Ford *et al.* 2007; Sanmartin *et al.* 2007). Long-distance dispersal mediated by West Wind Drift and the Circum-Antarctic Current has also been invoked to explain the floristic similarities in Australia, New Zealand and South America (Sanmartin *et al.* 2007), however, it seems most likely that its impact has been on those groups that have undergone more recent radiations (<30 My B.P.).

Our ability to recognise long-distance dispersal has been difficult because the mechanisms for transoceanic dispersal remain poorly understood (Knapp *et al.* 2005) and dispersal is thought to be due to largely stochastic events (Turner *et al.* 2006). Divergence time analysis and the level of utility of various chloroplast, nuclear and DNA regions for phylogenetic analysis provide a guide in interpreting the ages of the lineages being studied and allow speculation as to whether dispersal or vicariance should be invoked to explain the current distribution of these sister taxa.

The attractiveness of using vicariance to discuss biogeographical relationships is that it is possible to postulate, based upon geological history of the break-up of Gondwana, a temporal framework for the evolution of these sister-groups. The molecular data used to interpret relationships in the Tasmanian endemics have been largely *rbc*L sequences (Table 1) and the long branch lengths of many of the trees suggest that this group of sister taxa are all ancient Southern Hemisphere lineages. Long-distance dispersal cannot be dismissed completely, but vicariance is favoured as the most likely explanation for their current distribution.

The earliest separation applies to the movement of Africa (together with Madagascar and India) from the rest of Gondwana 105 My B.P. (McLoughlin 2001). The current biogeographical distribution of the *Schizomeria* clade and the sister taxa relationship between the Tasmanian endemic *Anodopetalum* and *Platylophus* from South Africa would suggest a Cretaceous origin for this clade.

The separation of the New Caledonia/ New Zealand subcontinent from the rest of Gondwana, which included Australia, is estimated to have commenced before 80 My B.P. (Wilford and Brown 1994). The sister taxa relationship between the Tasmanian endemic *Campynema* and *Campynemanthe* from New Caledonia therefore implies a Cretaceous age for this clade. A similar age for *Lagarostrobos* and *Manoao*, from Tasmania and New Zealand respectively, is also considered likely, because New Zealand started its separation from Australia about 80 My B.P. and the Tasman Sea reached its present-day size about 65 My B.P. (Wilford and Brown 1994; McLoughlin 2001).

Two Tasmanian genera, *Diselma* and *Prionotes*, have sister taxa in South America. It is estimated that Australia separated from Antarctica and South America about 35 My B.P. (Veevers *et al.* 1991) and therefore it is reasonable to postulate a more recent Late Cretaceous/Early Tertiary age for *Diselma*. As *Diselma* and *Fitzroya* are sister to *Widdringtonia*, from southern Africa, an older Cretaceous origin for this larger clade would, however, be inferred. *Prionotes* is sister to *Lebetanthus*, which would imply a minimum 35 My B.P. age for the divergence of these two genera, although the *Prionotes/Lebetanthus* clade is the basal clade within the subfamily Styphelioideae, and an older age for the clade is considered likely.

Limited fossil data provide additional support for interpreting the conifers, *Athrotaxis*, *Diselma*, *Lagarostobos*, *Microcachrys*, and the monocot, *Milligania*, as palaeoendemics. The conifer taxa are phylogenetically and biogeographically isolated and they may represent, as Page and Clifford (1981) and Hill (1995) have suggested, the last extant remnants of previously more specious lineages. Tasmania was a refuge for their survival and there is little evidence, with the possible exception of *Lagarostrobos* and *Microcachrys* that they have occurred outside the state.

A third group, which includes *Agastachys, Cenarrhenes* and *Planocarpa,* are typically basal members in their clades, and their biogeographical links lie with mainland Australia.

Western Tasmania has been recognised as a centre of endemism (Burbidge 1960; Hooker 1860; Schodde 1989), but it is probably more accurate to think of it as an important refugia for many old relictual genera (Page and Clifford 1981). Nelson (1981) pointed out that other genera, including *Anemone, Aristotelia, Caltha, Gunnera, Coprosma, Elaeocarpus, Eucryphia, Pherosphaera, Nothofagus, Oreobolus, Ourisia, Podocarpus* and *Phyllocladus* have closely related species in other southern temperate lands, and he argued that Tasmania's insularity, southerly position and its relatively mountainous topography has led to the persistence of these genera on the island. Tasmania's stable geology is also considered to be an additional factor that has led to the relictual nature of the flora.

Tasmania has a stable geological history and is part of the Australian Plate. The current Bass Strait is a relatively recent marine incursion separating mainland Australia from Tasmania, although this area has been exposed and flooded repeatedly since the Oligocene (BMR Palaeogeographic Group 1990). The flooding of Bass Strait is not likely to have had any impact upon the older genera, although it may have impacted upon those groups that have undergone a more recent radiation.

A local sifting of plant communities also occurred in response to the changing climates during the Cenozoic, and more recently during the glacial and interglacial periods in the Quaternary. The cooling of the climate during the Tertiary also lead to the evolution of small-leafed (microthermal) species in some genera, like *Nothofagus,* by the Middle – Late Eocene (Hill *et al.* 1999a). The ongoing cooling of the climate into the Oligocene and the additional evidence of microphyllous angiosperms and conifers from high altitude fossil sites, such as the Late Oligocene – Early Miocene Monpeelyata locality (Macphail *et al.* 1991; Hill and Scriven 1997), which, at 920 m a.s.l. today, suggest altitudinal stratification of the Tasmanian vegetation had occurred by this time. It seems reasonable to hypothesise that the early alpine floras, which included alpine herbs like *Pterygopappus,* the shrub *Planocarpa,* and the lily-like plant *Milligania,* had appeared by this time.

A second group of Tasmanian genera are interpreted as neoendemics. Through analysis of data from more rapidly evolving sequences (e.g. ETS, *atp*B–*rbc*L intergenic region), the shrubs *Odixia* and *Stonesiella* are interpreted as relatively recent segregates within their groups (Bayer *et al.* 2002; Orthia *et al.* 2005), and this appears likely for *Asterotrichion* as well. The status of these taxa is equivocal and it is thought that further phylogenetic research may not support their generic status. Both *Odixia, Stonesiella* and *Asterotrichion* have sister taxa in Tasmania and/or mainland Australia which indicate they are derived from Australian lineages.

The aridification of the climate from the Miocene onwards led to the differentiation of vegetation and the evolution of open (*Eucalyptus*) forests and a radiation of plants in various sclerophyllous families (Martin 1994, Macphail *et al.* 1994). Bayer *et al.* (2002) argued that the increasing aridity of the climate during the Miocene led to a massive radiation in the Gnaphalieae (Asteraceae). Crisp *et al.* (1999a) similarly suggested that an explosive radiation occurred within the tribe Mirbelieae (Fabaceae). It seems likely that the Tasmanian neoendemics have evolved to occupy the understorey habitat in temperate *Eucalyptus* forests that dominate much of the south-east Australian landscape. Molecular clock analyses of selected genera suggest that there has been a similar radiation, since the Middle Miocene, in the Restionaceae and genera in other families in South Africa (Linder *et al.* 2003 and references therein). It seems likely that the radiation of these taxa in Australia and southern Africa may be due to climate change initiated by the formation of the Circum-Antarctic Current (Macphail *et al.* 1994).

Two genera from western Tasmania were of uncertain status. *Pterygopappus* is an alpine genus and while an early offshoot in its clade it is of uncertain status in terms of its endemicity. *Winifredia* is somewhat anomalous, with regard to the other endemic genera in being restricted to western Tasmania at low altitude (Briggs *et al.* 2000).

CONCLUSION

The study shows that different sets of sequence data were needed to examine their phylogenetic relationships of the endemic genera of Tasmania, and this suggests that they are a heterogeneous assemblage of taxa. There is therefore little taxonomic equivalence between some genera and the concepts that define some taxa will change as additional information becomes available. It is also reasonable to extrapolate that the different genera have clearly evolved at different times and in response to different evolutionary pressures, and therefore have different histories and occupy different places in time and space. As Gadow (1913 p. 13) expressed it, 'the key to the distribution of any group lies in the geographical configuration of the epoch in which it made its first appearance'.

Two broad groupings of endemic genera are proposed and it could be argued that this division into neoendemics and palaeoendemics is artificial. If these groupings were indeed merely two ends of a continuum, then the corollary is that multiple patterns, of different ages, occur in Tasmania. Study of the endemic genera therefore suggests that Tasmania should be defined as a 'composite' region (*sensu* Crisp *et al.* 1999b), and the history and biogeographical relationships of the flora are complex. The likelihood of finding congruence between genera is therefore diminished.

The palaeoendemics in Tasmania occur in the aseasonal-wet biome. Crisp *et al.* (2004) concluded that taxa that are largely restricted to this biome, e.g. *Nothofagus*, Podocarpaceae and Araucariaceae in Australia, did not radiate to any extent or have become locally extinct in parts of Australia. Not all genera in Australia, however, have responded to the changing climate in the same way. Other genera, like *Elaeocarpus* (Elaeocarpaceae) and

Ceratopetalum (Cunoniaceae), which occur in the aseasonal-wet biome of northern Australia, have undergone a relatively recent radiation. Also genera in some clades, e.g. *Cenarrhenes* clade, occur in more seasonal biomes, and this similarly appears to be in response to the aridification of the Australian climate.

There are a number of broader implications of this study for biogeographical analysis. Biogeographical studies are more likely to find congruence if patterns are sought from elements within the same biome. Attempts to find congruence are also likely to fail if composite areas were treated simplistically as a single region. The corollary of this for biogeographical studies is that congruent area patterns will only be found if genera have a similar history and have responded to events, such as vicariance, geodispersal, i.e. bringing biotas into contact through tectonic movements (Ladiges and Cantrill 2007), and/or long-distance over-water dispersal, in the same way. Study of the palaeoendemics in Tasmania indicates that there is limited congruence in their biogeographical relationships.

The difficulties in finding congruence in biogeographical relationships are due to (a) stochastic events such as dispersal (Knapp *et al.* 2005), (b) real extinctions as evidenced from the fossil record (e.g. Swenson *et al.* 2001), (c) implied extinctions that are suggested by 'missing' sister linkages (Linder and Crisp 1995), (d) different biomes having different histories (Crisp *et al.* 2004) as shown in this study coupled with the antiquity of many of these lineages. Limitations in the geological data available to adequately understand the history and extent of some biogeographically significant landmasses in the past, e.g. New Zealand and New Caledonia (Ladiges and Cantrill 2007), are also a complicating factor. The biogeographical relationships of the endemic genera, where they can be determined, do clearly indicate a Southern Hemisphere origin for all genera. The study shows both the diversity and complexity of long distance relationships between the endemic genera in Tasmania and their sister taxa in other Southern Hemisphere regions. Our inability to resolve the biogeographical relationships of five genera, one quarter of the taxa, suggests that the likelihood of finding congruence between different sets of taxa is inversely proportional to the age of the lineage being studied.

This study shows that Tasmania is an important refugium for a large number of archaic endemic genera, and the entire genetic diversity of these taxa, being an island flora, lies within a single biogeographical region. The *Threatened Species Protection Act 1995* in Tasmania includes endemic genera if they are listed as threatened species. The Act, however, provides no protection to ensure that the genetic diversity within widespread endemic genera is also preserved. Fortunately, however, most of the endemic genera occur in the western half of the state and are protected by an extensive national park system and World Heritage conservation areas.

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Addendum

The status of the endemic species *Ammobium calyceroides* Cass has been discussed by various workers (Anderberg 1990, 1992; Orchard 1992). Buchanan (2007), in the latest electronic edition of the 'Census of the vascular plants of Tasmania', has supported placement of this species in monotypic genus *Nablonium* Cass. If this view were to be accepted then an additional endemic genus would occur in Tasmania.

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A NEW GENUS AND SPECIES OF ISOTOMINAE (COLLEMBOLA: ISOTOMIDAE) FROM CUSHION PLANTS ON SUB-ANTARCTIC MACQUARIE ISLAND

Penelope Greenslade and Mikhail Potapov

Greenslade, Penelope and Potapov, M. 2008. A new genus and species of Isotominae (Collembola: Isotomidae) from cushion plants on sub-Antarctic Macquarie Island. *Kanunnah* 2: 87–97. ISSN 1832-536X. A new genus of a blind, white isotomid, *Azoritoma* n. gen. and new species *A. macquariensis*, is described from Macquarie Island. The species has only been found in association with the cushion plant, *Azorella macquariensis* Orchard, on the plateau of Macquarie Island at an altitude of 260 m. A table of characters is provided to distinguish the new genus from other, similar genera of blind, white Isotomidae and some ecological notes on the new species are included.

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KEY WORDS: *Azoritoma macquariensis*, *Azorella macquariensis*, endemic genus, endemic species, climate change.

The collembolan fauna of sub-Antarctic Macquarie Island is well known in comparison with Australian islands with warmer climates. This is due, in part, to the fact that for nearly 100 years specimens have been collected and recorded from Macquarie Island, the first of those being *Hypogastrura viatica* (Tullberg 1872), which was collected by G. Hamilton during the Australian Expedition of 1911–13. In addition, the collembolan fauna of Macquarie Island consists of relatively few species compared to more temperate islands of a similar size; Greenslade (2006) recorded only 34 species on Macquarie Island. Consequently cumulative species curves reach saturation after relatively few collections.

Endemism for Collembola and for other terrestrial animals is considered to be low on Macquarie Island (Greenslade 1990, 2006). Studies, however, which use molecular data to distinguish species, may uncover cryptic, endemic island species. Stevens *et al.* (2006) used molecular data to shown that Collembola specimens from the island, previously identified as a single species, *Cryptopygus antarcticus* Willem, 1901, probably include three taxa.

The new species of Collembola was collected for the first time from the island by Rounsevell in 1972, and it was provisionally identified as *Isotoma* (*Pseudosorensia*) *atlantica* (Wise 1970) a species only known previously from South Georgia (Greenslade and Wise 1986). Some doubt was expressed by Greenslade and Wise (1986) as to its correct identification and a few details of its morphology, including several figures, were included in their published paper. Macquarie Island individuals were smaller, lacked ocelli or any pigmented eyespot compared to the described species. The specimens were subsequently referred to as *Isotoma* (*Pseudosorensia*) sp. nr. *atlantica* by Greenslade (1990) and *Pseudosorensia* sp. nr. *atlantica* by Greenslade (2006). A detailed study of the species morphology has now been made on material collected in 1986–87 by the senior author, which shows that the sensorial chaetotaxy of the Macquarie Island species differs markedly from that of *Pseudosorensia atlantica* as redescribed by Potapov (1989) (as *Isotoma atlantica*) from South Georgian material. Moreover, based on this and other characters, the Macquarie Island species cannot be assigned to any existing genus and so a new genus is erected for it here. The species appears to have a restricted distribution on Macquarie Island; it has only been found, thus far, at one locality and in one habitat, the cushion plant, *Azorella macquariensis* Orchard.

Abbreviations

- Abd. Abdomen, abdominal segments.
- Ant. Antenna, antennal segments.
- AO Distal sensory organ on antennal segment III.
- Th. Thorax, thoracic segments.
- ms microsensillum.
- s sensillum/a.
- PAO Postantennal organ.
- MSPU Moscow State Pedagogical University, Russia.
- SAMA South Australian Museum, Adelaide, South Australia.
- SMNG Staatliches Museum für Naturkunde Görlitz.

SYSTEMATICS

Family Isotomidae
Subfamily Isotominae
Azoritoma n. gen.

Diagnosis: Isotominae with all abdominal segments separate including abdomen V and VI, no abdominal segments fused, dens crenulated, longer than manubrium, ocelli absent, pigment absent, postantennal organ present and well developed, antenna IV with 6 thick sensilla, the most distal thicker than the others, labial palp bifurcated with 2 sublobal hairs, maxilla with reduced teeth on capitulum, manubrium lacking distal medial setae anteriorly, anterior chaetotaxy of dens with more than 30 setae, mucro with 4 teeth, sensorial chaetotaxy of abdomen V with 1 + 1 broad anterior and 4 + 4 medial thinner s setae.

Type species: *Azoritoma macquariensis* n. sp.

Systematic discussion

The new genus belongs to the subfamily Isotominae Schäffer, 1896 *sensu* Potapov (2001) because of the numerous setae on the anterior side of manubrium. *Azoritoma* n. gen. is clearly distinct from other genera of Isotominae based on three characters: 1) a characteristic modification of the outer and inner mouthparts (the maxillary head and outer maxillary lobe are particularly unusual); 2) a strongly reduced and differentiated sensillary chaetotaxy; and 3) a loss of setae from the anteriomedial face of the manubrium.

Firstly, the reduction of the maxillary claws (teeth) in *Azoritoma* is otherwise unknown in the family. Secondly, in Isotominae, there are normally 4 sublobal hairs on the maxillary outer lobe and they are always shorter than the maxillary palp, not two and longer as in *Azoritoma*. Thirdly, the small number of sensilla on body is rare in Isotominae except for *Sericeotoma* Potapov, 1991, a Palaearctic genus known from the Ural Mountains and *Isotoma atlantica* (Wise 1970) *s.l.* from South Georgia, the generic placement of which is still uncertain. Thickened sensilla on body are sometimes present in unrelated taxa of Isotominae, for instance *Heteroisotoma stebaevae* (Rusek 1991) and *Isotoma mackenziana* (Hammer 1953), but are so far unknown in genera of small sized animals such as *Parisotoma* Bagnall, 1940 and *Pseudosorensia* Izarra, 1972. Species in the genus *Arlea* Womersley, 1939 from South America and South Africa, have a similar sensillary pattern on Abd V (Abrantes and Mendonça 2005; Mendonça *et al.* 2006) but the genus belongs to subfamily Anurophorinae Börner, 1906 *s.l.* because it has only one pair of anterior manubrial setae. Finally, the loss of setae from the anteriomedial group on the manubrium of *A. macquariensis* distinguishes it from all other small, blind members of the genera *Parisotoma* and *Pseudosorensia*. The same condition is only found in *I. atlantica*. *Isotoma atlantica* does not belong to the genus *Isotoma* due to the presence of 1 + 1 ocelli and a pigmented eye patch. Although a mucro with 4 teeth is found very occasionally in *Parisotoma*, the arrangement of the teeth is different from that of *Azoritoma*.

Azoritoma macquariensis n. sp.

Material Examined

Holotype: Adult Female, in *Azorella macquariensis* plants, at junction of Bauer Bay and Doctors Tracks, on plateau, Macquarie Island, 260 m a.s.l., 14.xii.1986, collected by P. Greenslade. Reg. no. SAMA I22626.

Paratypes: 11 Females, same data as holotype, reg. no. SAMA I22627; 20 Females, in alcohol, same data as holotype, SMNG; 2 Females on slide, MSPU.

Additional material: Collections 4/1, 4/2, on plateau, Macquarie Island, xi.1972, collected by D. Rounsevell, SAMA.

External Morphology

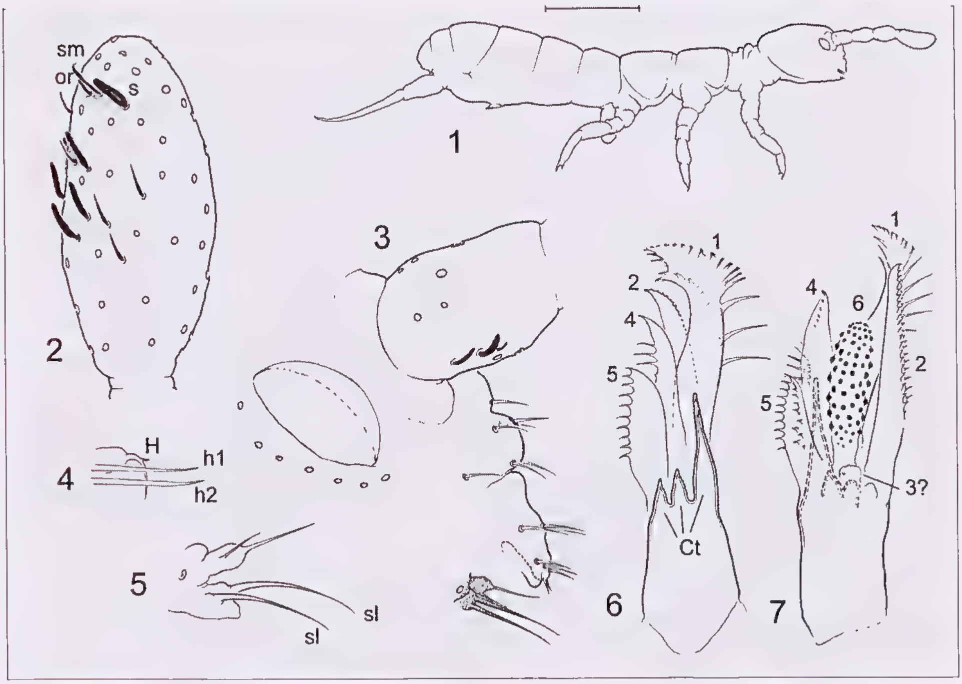
Body length: 0.48–0.53 mm. White, totally lacking pigmentation.

Antennae: Ant.I with 3 sensilla dorsally (1 moderately thickened, almost seta-like, 1 thickened and large, and 1 short (Fig. 3)) and with 1 or 2 (variable) microsensilla ventrally. Inner sensilla of AO of Ant.III broad, almost spherical, outer sensilla rather short (see Greenslade and Wise 1986; Fig. 1). Ant.IV with 5 sensilla moderately thickened, 1 thicker and positioned more distally and some thin sensilla (Fig. 2). Subapical microsensillum long, organite stick-like.

Head: Ocelli absent. PAO about as long as width of Ant.I (Fig. 3). Labral formula 2/554, in prelabral area 2 additional setae present, possibly prelabral (if so, labral formula 4/554) but frontal setae appear to be positioned ventrally (Fig. 16). Apical labral setae half length of rest, inserted near to distal margin, so area of apical folds and apical folds entirely absent (Fig. 3). Maxillary outer lobe with 2 thick, long sublobal hairs and bifurcate apical palp (Figs 3, 5). Labial palp generally normal for family with 5 papillae (A–E) and full set of guards (16, incl. e7), lateral process as for family. Hypostomal setae h1 and h2 well developed, seta H weaker, curved and armed with denticle on outer side (Fig. 4). Labium with 4 + 4 basomedian, 5 + 5 basolateral, and 3 + 3 proximal setae. 3 + 3 postlabial setae (Fig. 16). Mouthparts considerably modified. Mandibles distally more slender than in most Isotomidae. Five elongate lamellae on maxillary head (1, 2, 4–6) (Fig. 7), lamella 3 probably lost or present as a small swelling (denticle) at the base (sometimes visible) (Fig. 7). Maxillary teeth on capitulum strongly reduced, only 1 clearly visible, but rather thin, appears to have 2 blunt teeth at the tip, 2 other teeth small, slightly pointed or variably blunt, inconspicuous (Fig. 6).

Thorax: Legs with few setae. Tibiotarsus I and II with 21 setae each, III with approximately 25 setae; all legs with only 7 setae in apical whorl (Fig. 13). Pretarsus with 2 small setae. Claw without lateral or internal teeth. Empodial appendage with broad lamellae. Ratio of length of claw III (measured internally): length of empodial appendage III = 1.3. Ratio of length of PAO: length of claw of leg III (measured internally) = 1.80

Abdomen: Ventral tube with 2+2 lateral, 2+2 anterior, and usually 3 posterior setae (see Greenslade and Wise 1986; Fig. 3). Retinaculum with 4+4 teeth and 1 seta (1 specimen with 2 setae). Anterior furcal subcoxa with 17–20 setae, posterior subcoxa partly fused with tergite as in

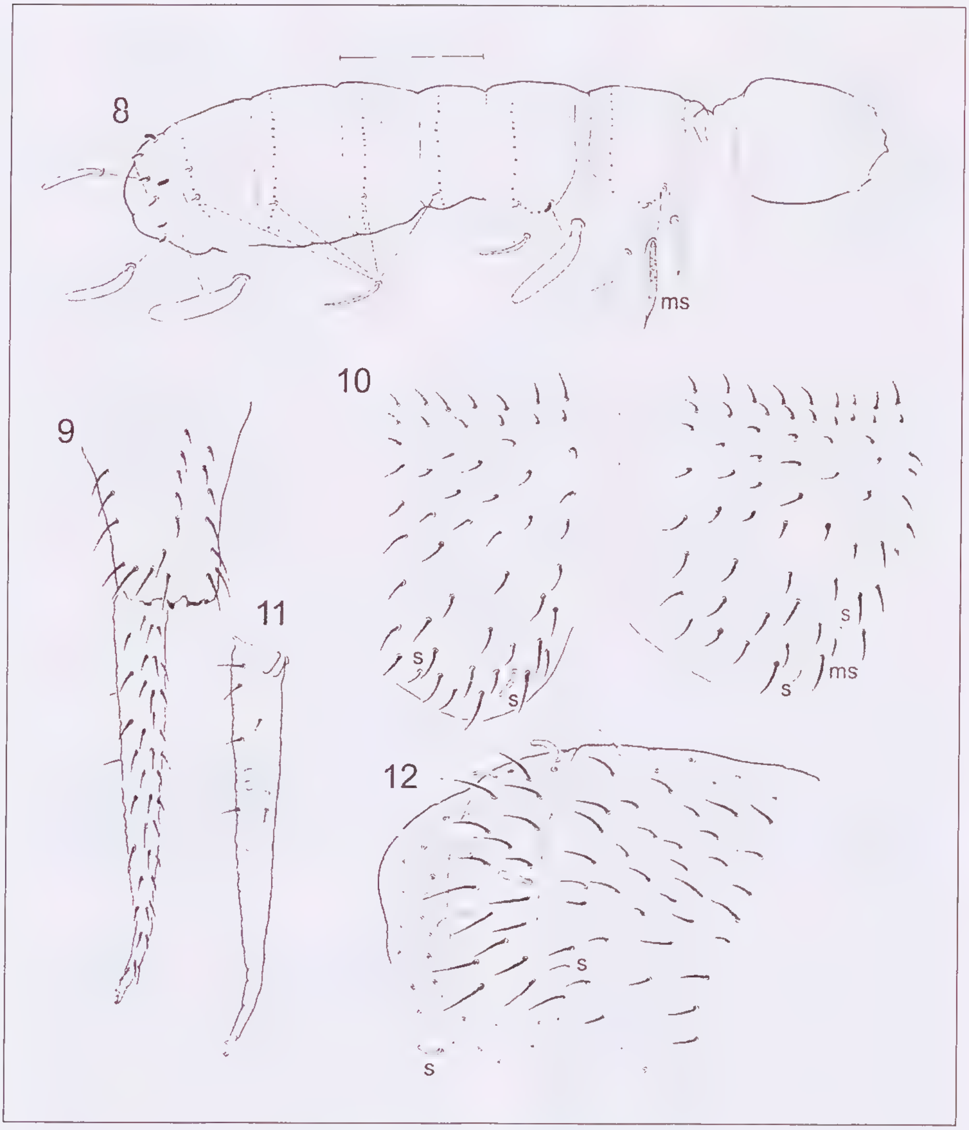


Figs 1–7. *Azoritoma macquariensis* adult female.

1. Habitus; lateral view. Scale line represents 0.1 mm. **2.** Ant.IV showing sensorial setae with thicker distal sensillum. **3.** Lateral view of head and Ant.I showing PAO, Ant.I sensilla, maxillary palp (shaded), labral and preclypeal (frontal) setae. **4.** Hypostomal setae with small barbed H seta, and long h1 and h2 setae. **5.** Maxillary palp, bifurcate with two long sublobal hairs. **6.** Maxillary head, Ct-reduced teeth of the capitulum and five lamellae 1–2, 4–6. **7.** Maxillary head, alternate view, showing five well-developed lamellae, lamella 3 possibly rudimentary. sm – subapical microsensillum; or – organite; sl – sublobal hair.

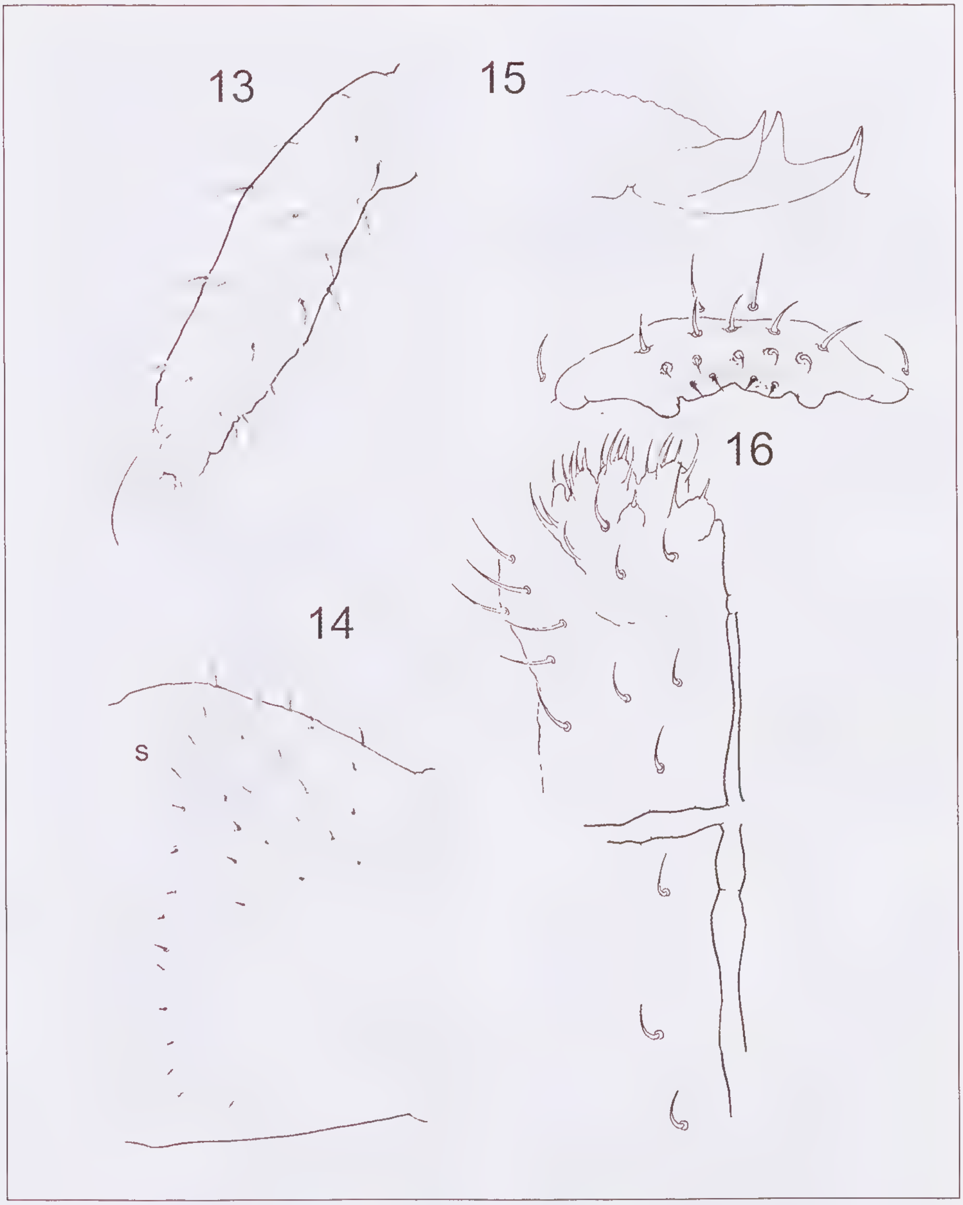
related genera. Manubrial thickening simple as for family. Anterior manubrium with approx. 18 setae. Medial setae in apical part of anterior face of manubrium absent (Fig. 9). Dens with 36–39 setae on anterior and 6 setae on posterior side (2 basal, 2 inner and 2 outer) (Figs 9, 11). Mucro with 4 teeth (3 is usual for most species of *Parisotoma*), fourth tooth minute, anteriodistal in position and obscure in dorsoventral view (Fig. 15). Ratio of length of manubrium: length of dens = 0.49 (measured laterally).

Chaetotaxy: Ordinary setae slightly thickened, smooth and short. A range of anterior and lateral ordinary setae on abdomen II absent (as in *Isotomiella symmetrimucronata* Najt and Massoud, 1987) (Fig. 14). Axial chaetotaxy for Th.II–Abd.III normally 9, 6–7/3, 3, 4 respectively. Macrochaetae hardly differentiated, smooth, shorter on Abd.V than length of tergite (Fig. 12). Ratio of length of Abd.V macrochaetae:length of Abd.V (measured laterally) = 0.59. Sensillary chaetotaxy as 2, 2/1, 1, 1, 2(1), 5 (s) and



Figs 8–12. *Azoritoma macquariensis* adult female.

8. Dorsolateral view of body showing position and form of sensilla. Scale line represents 0.1 mm. **9.** Anterior view of manubrium and dens, distal apical area of manubrium lacking setae indicated with dotted line (only in adult). **10.** Dorsolateral view of Th. II and III showing full chaetotaxy. **11.** Posterior view of dens. **12.** Laterodorsal view of Abd.IV, V and VI showing ordinary setae and sensilla. ms – microsensillum; s – sensillum.



Figs 13–16. *Azoritoma macquariensis* adult female.

13. Anterior view of distal portion of tibiotarsus and claw of leg III. **14.** Lateral view of Abd.II showing chaetotaxy and area of missing setae. **15.** Mucro, lateral view. **16.** Ventral view of head showing labrum and right labium, ventral groove and post labial setae.

1, 0/0, 0, 0 (ms) on Th.II–Abd.V and on Th.II–Abd.IV respectively. Lateral sensilla sometimes absent on Abd.IV. Lateral sensilla on Th.III and all sensilla on Abd.V considerably thickened (Fig. 8). Following the notation of Potapov (1985) the number of ordinary setae between median line and sensilla on Abd.I–IV as 6_s, $6–8_s$, $8–9_s$, 2_s+2_s Microsensilla on Th.II somewhat longer than sensilla on this segment.

Ecology

Azoritoma macquariensis shows adaptations to an euedaphic way of life with loss of ocelli and pigment, as well as development of particular sensilla on Ant.I and Abd.V. Species of other genera of Isotomidae that live in below-ground habitats, such as *Folsomotoma* Bagnall, 1949, *Folsomina* Denis, 1931, *Arlea* Womersley, 1939 and *Isotomiella* Bagnall, 1939 also have enlarged sensilla on antennae and/or abdomen V. The unusual modification of mouthparts in this species is likely to be related to the specialised habitat in which it is found.

General discussion

Azorella macquariensis is a plant endemic to Macquarie Island. A closely related species, *Azorella selago* Hook.f., occurs widely in the sub-Antarctic, as well as being found outside the sub-Antarctic region *sensu stricto* on Amsterdam Island, the Falkland Islands, the Kerguelen group, Marion and Heard Islands, but, so far, both the plant and the collembolan, *A. macquariensis*, have only been found on Macquarie Island. *Azorella* species are slow growing and have a compact form. Old leaves are retained under the green compact surface forming a moist, humus-like mass of organic matter in which an array of Collembola and Acarina species can be found (Hugo *et al.* 2005; P. Greenslade unpublished results). The plant, *A. selago*, is considered a 'keystone' species in fellfield communities since it can act as a sentinel for climate change and thus its responses to increased temperatures and shading have been studied (Le Roux *et al.* 2005; McGeoch *et al.* 2006). The experimental manipulation led to less compact plants with a resultant loss of surface integrity. For a species such as *Azoritoma macquariensis*, which appears to require an edaphic-like habitat protected from wind, rain and extreme temperatures, warming climates are therefore likely to be detrimental to its survival. The other threats to the integrity of the Macquarie Island plant community that contains *Azorella* are damage caused by a large and growing population of rabbits, as well as attack from a fungal disease similar to *Rhizoctonia* (D. Bergstrom pers. comm. 2006). Isotomid Collembola have been shown to graze on *Rhizoctonia* on wheat roots in Europe (Sabatini and Innocenti 1995) but they may also aid in the dispersal of the disease. So whether *Azoritoma macquariensis* has a beneficial or deleterious effect on *Azorella* by feeding on the fungus is unknown and likely to depend on the density of both plants and animals.

Although *A. macquariensis* has so far only been found within *Azorella* plants, it is also likely to occur, but at lower densities, below the ground surface in the matrix surrounding the plants, as do other Collembola species that are found within *Azorella* cushions (Barendse and Chown 2001; Barendse *et al.* 2002). Obligatory, or even less rigid, associations of Collembola species with particular plant species are

GENERA

Character	***Azoritoma***	***Parisotoma***	***Pseudosorensia***	***Arlea***
Reference	This work	Potapov 2001	Izarra 1972; Wise 1970; Potapov 1991	Abrantes & Mendonça 2005; Mendoça *et al.* 2006
Abd V and VI	separate	separate	fused	fused
Mucronal teeth	4	3 (4 rare)	3	1
Anterior setae on manubrium	>15	>15	>15	1 + 1
Ant.IV sensilla	6 distal one thicker	5	unknown	7–10
Maxillary palp	bifurcate	trifurcate	unknown	unknown
Sublobal setae	2	4	unknown	unknown
Sensilla on Abd.V	1 + 4 thickened	2 + 5 not thickened	unknown	1 + 3 thickened
Distal medial setae on anterior face of manubrium	absent	2 + 2	2 + 2	absent
Ciliated macrochaetae	absent	present or absent	present or absent	absent

Table 1. Differentiating characters for three genera of Isotominae and one of Proisotominae that include white species with reduced ocelli.

rare but have been recorded twice before in Australia (Rodgers 1997; Driessen and Greenslade 2004). Further sampling on the island is needed to establish the true habitat range of the new species.

Endemism in terrestrial plants and animals is generally considered to be low on Macquarie Island, although deep soil species and freshwater aquatics seem to have a higher proportion of endemics than epigaeic species (Greenslade 2006). There is only one other endemic genus on Macquarie: an aquatic worm, *Macquaridrilus bennettae* Jamieson, 1968 which is a tubificid oligochaete. Among the 30 species of Collembola found on Macquarie Island, only *Katianna banzarei* Salmon, 1964 and a possible undescribed marine littoral *Archisotoma* species are currently considered endemic. The new genus is therefore a significant addition to the uniqueness of the fauna of the island.

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